ENGINEERING NEWS.

AND

AMERICAN CONTRACT JOURNAL.

THE SAINT GOTHARD RAILWAY.

(Translated from *Les Travaux Publiques.*)

The Saint Gothard continues to form a subject for much discussion among engineers, owing to the great technical difficulties that had to be overcome, and which possess in some respects an element of novelty. In fact the differences of height of the mountain were very numerous.

Fig. 1, 2 and 3 show the normal profile of the railway in the cuttings and embankments. The walls of the cuttings in the rock are always vertical when the rock is sufficiently resisting. Wherever the parts were liable to scaling, a slope of 45° was given to the talus. When the cutting was through loose material, the talus was given an inclination of 1 to 1.25, and the sides were covered with rubble work. In other sections loosec stone walls were built as a breast. Figs. 4 and 5 give the transversal cut of these walls. The first type is designed to maintain a mass of earth of 27 meters high, and leaning on a rocky side. The wall is two meters in thickness, 8 meters in height and has a side inclination of 1¼.

The second type is intended to prevent the sliding of a mass of earth covering a rocky subsoil in which the breast wall is implanted.

For embankments a normal slope of 1.50 of base to 1 in height, and of 1.25 of base to 1 in height were adopted, where the ground consisted of a mixture of sand and pebbles. The sides of the embankments built of this mixture were covered whenever possible with a layer of vegetable earth, or with a stone fencing of 0.60 thickness. Whenever stones were at hand the type used was that shown in Fig. 6, up to a maximum height of the embankment of 20 meters. It can be seen that the whole part of the embankment that is situated to the right is formed of a stone packing which acts as a breast wall. The stone packing has a maximum height of 12 or 15 meters, according to the nature and size of the materials disposable. Fig. 7 gives the profile that has been often adopted for parts of earthwork which rest on inclined side of the mountain. The mass of dry stones has an inclined talus of 1¾ of base to 1 in height. By using this arrangement retaining walls of masonry were dispensed with. The retaining walls, properly so called, were generally constructed with a batter of ¼. However, in certain cases they were given a vertical facing, as shown in Fig. 8. The wall is implanted on the rocky side of the mountain—the space comprised between the wall and this slope is filled in with stones. The road is built on this stone packing and protected against slides of the upper part of the ground by ashlar work and mortar.

The retaining walls were hollowed out when they reached a certain height, and viaducts ranging from 17 to 14 meters in height were thus obtained. Figs. 9 and 10 show examples of this kind of building, the arches are semi-circular, and have 10 meters span.

The same method was adopted for crossing spaces where there were no other resting point than the summit of isolated rocks; or where important retaining walls were on the brinks of ravines with very sloping sides (Fig. 11). Masonry has been generally preferred for viaducts. Figs. 12 and 13 represent a viaduct over ravine with steep inclined sides. In this particular case it was deemed prudent not to construct an aqueduct under embankment, which might be blocked up by matter carried away by rain and perhaps brought away with the earthworks.

Fig. 14 shows sufficiently how the tops of the aqueducts have been consolidated.

When the construction of the foundation of the viaduct piers presented too many difficulties or when the piers would be too high, iron constructions were preferred as they could be built with a greater span than masonry and consequently with fewer resting points. There are a certain number of viaducts with metal piers and roadbeds on the line. A mixed system was also adopted, in which the piers and abutments are of masonry and the roadbed of metal. Fig. 15 shows plans, elevation and transversal sections of this last type used in crossing the Kerstel brook. All of the metallic viaducts were built with ordinary commercial iron and on the simplest plan.

The line of St. Gothard comprises, in addition to the great tunnel under the mountain, a number of other tunnels, built sometimes for one track and sometimes for two.

Small tunnels were much used in crossing the chains of mountains, and those for a single track are 5.40 meters in height with width of 5 meters. Although almost everywhere was the compact rock, yet in places the fissures required a slight facing in ashlar masonry. Other tunnels were made for two tracks and are of two types, a facing being required where the rock was not consistent enough.

The grand tunnel itself is six meters in height under the key-stone, and eight meters in width. Figs. 16, 17 and 18 give a transversal section of the parts of the tunnel that are completed. Fig. 16 is a profile of the part of the tunnel cut through solid rock. (The scale is 1.125.) Fig. 17 is a profile where the ground seems liable to fall in, and here a facing of 0.90 meters was given. (The scale is 1.250.) The facing has the shape of an almost circular vault. There are two kinds of this tunnel according as they are furnished or not with bed-floor. Fig. 18 shows a tunnel with a facing of one meter—scale 1.250. Both common dynamite and dynamite gum were used; the latter is composed of 90 to 93 per cent. of nitro-glycerine and gelatine. The gelatine prevents the nitro-glycerine from oozing through, even under the enormous pressure of 1,000 kilos per square centimeter, which fact would seem to show that there must be something like a combination between these two substances. When the dynamite gum is left, however, a certain time in the water, there is a slight discoloration, but it reassumes the primitive color on contact with the air.

Water must be allowed to enter the tier vases, which have two sides. Zinc boxes, with a current of hot water between them, have been used for keeping the dynamite from freezing. Horse dung has been used even as a means of thawing, but for large enterprises a special shed is kept heated and provided with apparatus. Both priming and capsules were used. The priming was composed of 56 per cent. of nitro-glycerine; 34 per cent of saltpeter; 6 per cent. of carbon, and 4 per cent. of gunpowder cotton. These primings did not emit so many deleterious gases as the old one. (See Fig. 19.)

Opinions are very much divided as to the best arrangement for mining holes, and the proper depth to give them. In operating with percussion machines, the mines are fired by groups arranged according to the quality of the rock, the number of holes, etc. Fig. 20 is a transverse cut of a leading gallery of 6.2 metres 4 of section in a soft rock. Five holes are made, and the charges are fired in the order of the numbers. For a hard rock 7 or 8 holes are made in the same sized section of surface. For a medium surface of 6 to 6.2 ×4 in a soft rock of micaceous gneiss 18 borings of 1.30 m. to 1.40 m. may be made; in gneiss of medium hardness 20 borings of 1.30 and in hard rock (gneiss, granite, serpentine), 22 to 24 holes of 1.20 may be pierced, of which from 3 to 6 are in the middle to form rupture mines (Fig. 21). These well charged cause the first rupture, etc.

For enlarging banks dynamite gum was exclusively used. The upper part was blasted by gunpowder alone. The number of misses was very small. There were only four in the course of four months in the Pfaffensprung tunnel. Misses are due to four principal causes: 1. Rupture of the conducting wires by a neighboring explosion. 2. Separation of the priming or part of charge by the shaking causes, by explosion of a near-by mine, in which case only a part of the charge can remain in the mine. 3. Separation of the conducting wire from the priming when the heading cartridge is put on. 4. Putting out the slow match by water. None of these accidents happened with dynamite gum.

From all the experience it would seem that the relative quantities of dynamite gum and dynamite that are required to produce the same effect are in the proportion of

$$\frac{1}{1.43} \text{ to } \frac{1}{1.51} \quad \frac{\text{dynamite gum}}{\text{common dynamite.}}$$

At the same time there is an economy of labor of 20 per cent., and in the advancement of work of 15 per cent. by using the gum.

Some parts of the line run along lakes and ponds of water. Fig. 22 shows the system used to make the embankments and protect the talus. It consists in having a pitching carefully trowelled and resting on enrockments. The pitching extends sometimes to the water bed; sometimes the lower part stops at the level of the bed and the top at a

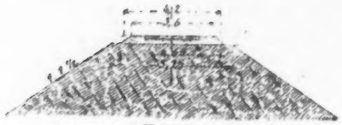
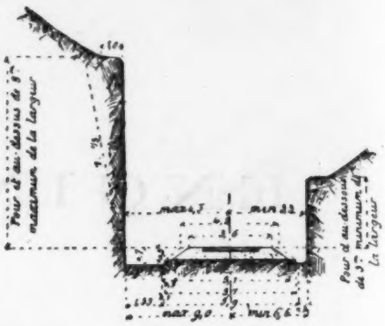


FIG. 1.

FIG 2.



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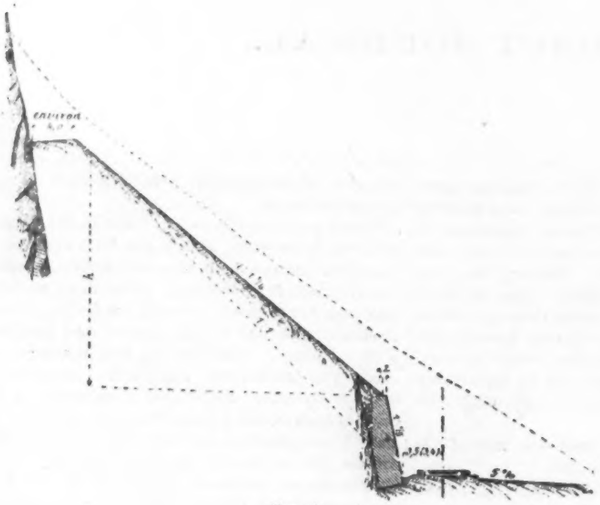

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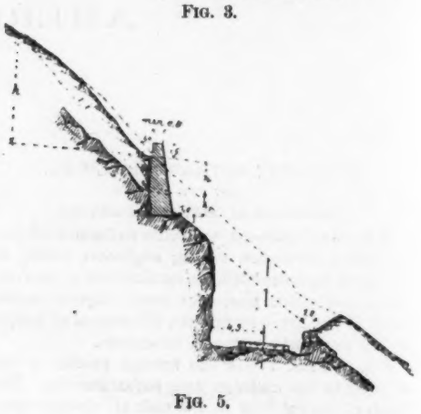

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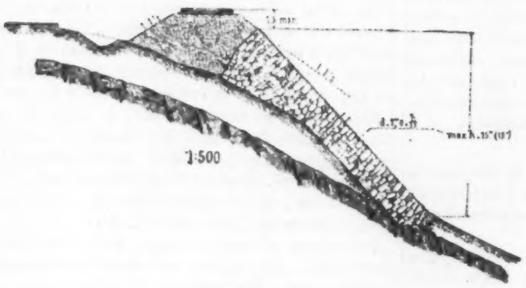

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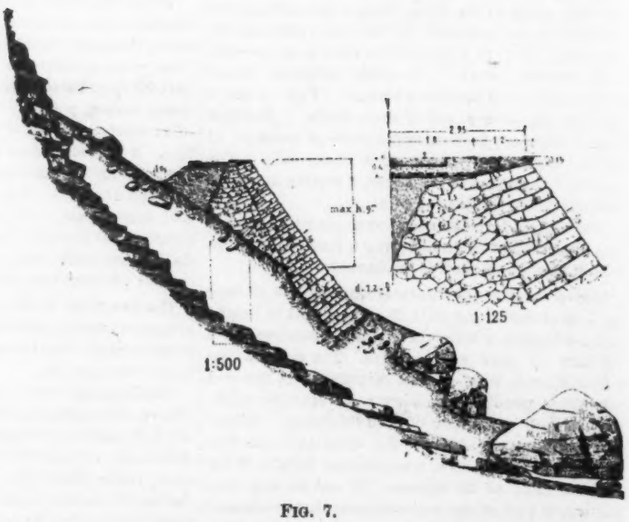

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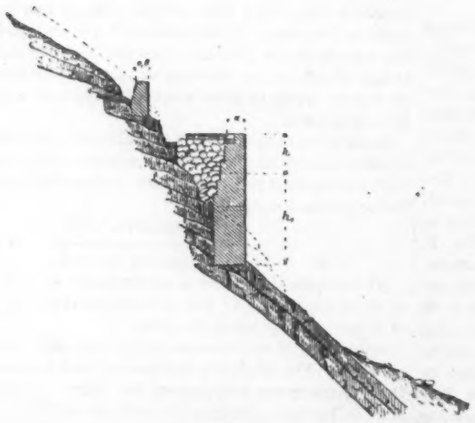


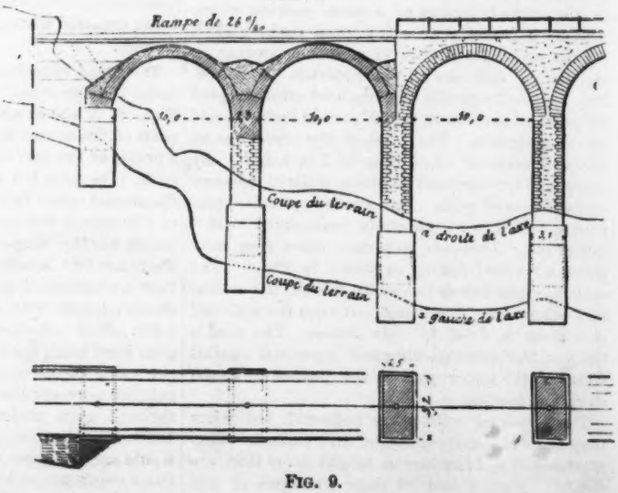
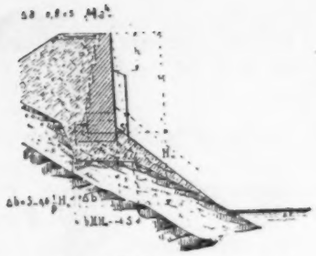


FIG. 9.

THE SAINT GOTHARD RAILWAY.

FIG. 13.



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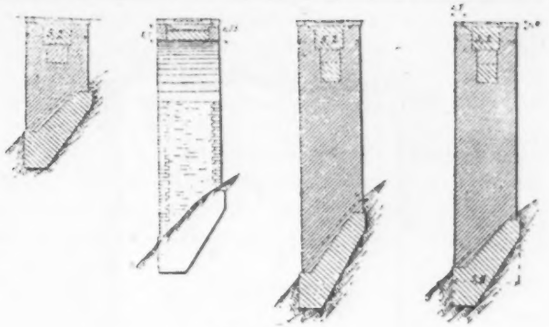

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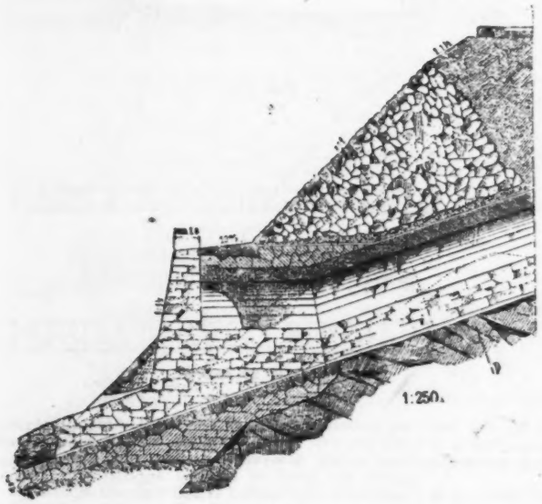

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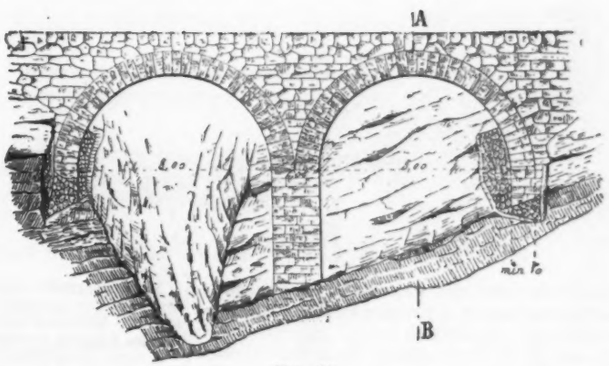

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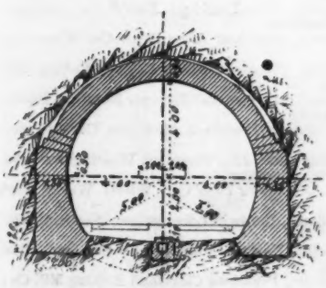
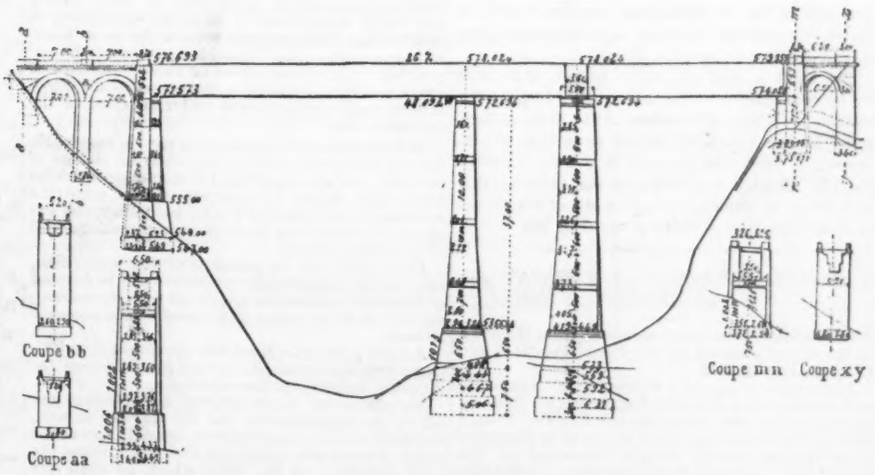


FIG. 17.



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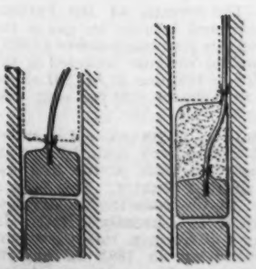

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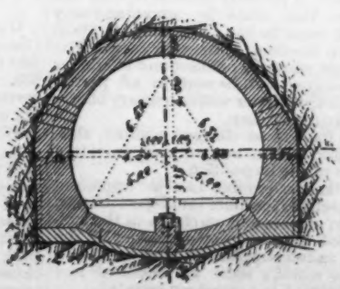

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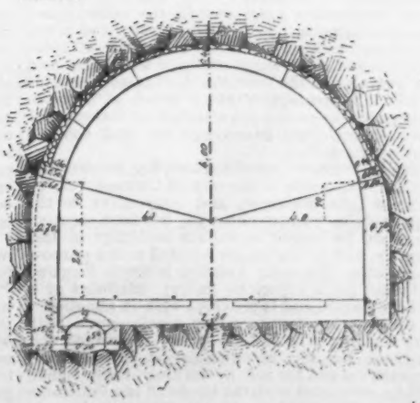

FIG. 16.

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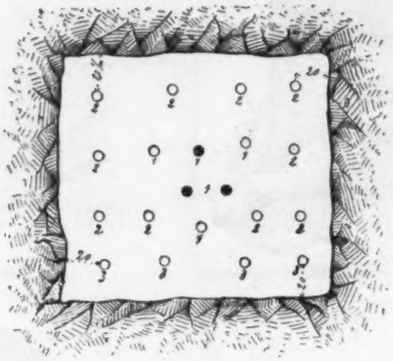
FIG. 20.



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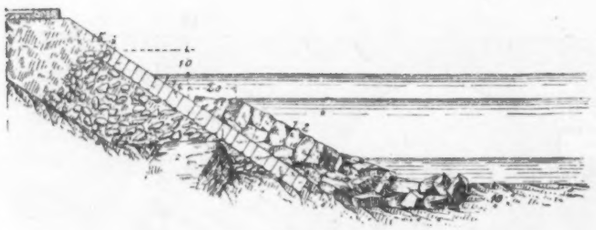

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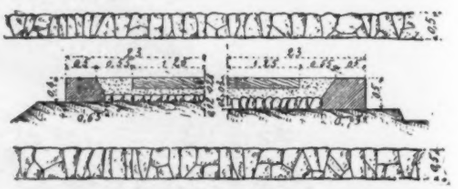

FIGS. 23 AND 24.

meter above the high water lever. The banquette of the enrockment is 2 meters in breath, and is at the level of ordinary high water. The enrockment is made of stones, double the size of those that the current can carry along. In some places water torrents had to be allowed to pass either over, or above, the railroad platform aqueducts with horizontal invert were used for the purpose.

The track is laid on a bed of ballast, of from 35 to 40 centimeters in thickness, according to the settling. When the ballasting is composed of small broken stones, a filling of from 12 to 20 centimeter in thickness, between it and the platform (fig. 23). Finally in some places the ballast is laid in a kind of cistern, the side walls of which are in stone 0.5 meter in width at top (Fig. 24).

NATIONAL EXPOSITION OF RAILWAY APPLIANCES.

The following circular was issued from the office of the commissioners, at the Grand Pacific Hotel. Chicago, Dec. 4, 1882 :

Almost a year ago, the feasibiiity of organizing and conducting a National Exposition of Railway Appliances at some favorable point in the United States and in the near future began to be discussed by prominent parties deeply interested in the growth and prosperity of this interest. A very thorough expression of the sentiment of railway men and inventors and manufacturers of and dealers in railway appliances has during this period been obtained, the universal tone of which has been enthusiastically in favor of the proposition.

Accepting this as a safe indication that an exposition can be organized which will reflect credit upon the result in great good to the railway, and manufacturing interests of this country and of the world, and believing that the magnitude of these interests and their wonderful growth in the past few years make the present a most auspicious time in which to accomplish this, a board of commissioners, whose names are attached to this circular has been organized to arrange for and conduct such an exposition.

The Inter-State Exposition building, located near the business center of the city of Chicago, on the shore of Lake Michigan, and convenient to the depots of the various railways, has been secured. These are the largest exposition buildings in this country, and are especially adapted to the purpose in question. The main building is 800 ft. long and 200 wide, has a capacious gallery one-third of a mile in length, and is provided with an abundance of steam power for operating machinery. Railway tracks will be laid the entire length of this building for the accommodation of cars and locomotives and for use in making tests, which will be connected with the tracks of the Baltimore & Ohio, Illinois Central and Michigan Central roads, running within a few feet of it eastern wall.

Most favorable rates will be given by the railways of the country for the transportation of articles intended for exhibition and excursion parties desiring to attend.

A series of scientific and practical tests, to be made by well-known scientists and carefully selected committees, extending to every article and every description of material susceptible of reliable test, will constitute one of the most interesting as well as most valuable features of the exposition. An official record of these tests and of every exhibit, including a list of prizes awarded, will be made and published under direction of the commissioners.

Exhibitors will be required to pay a reasonable fee for themselves and for employés in charge of exhibits, and an extra sum for each class in which they may desire to compete for a prize (the amounts to be hereafter fixed), to defray the expenses of conducting tests and examinations and of providing medals.

Every dollar of the proceeds of the exposition, after defraying necessary expenses, will be devoted to benevolent purposes connected with the railway service, to be hereafter designated by the commissioners.

A large guarantee fund has been raised in Chicago, sufficient to insure beyond peradventure the financial stability of the exposition.

No officer or commissioner will receive any salary or compensation for his services as such, the good of the great interests named, and of the army of employés connected with them being the only incentive to the labor which he shall perform.

The exposition will open on or about Thursday, May 31, and close on or about July 7, 1883, and the time for preparation being thus limited, it is important that all who intend making exhibits shall begin necessary preparations at once.

It is requested that each person or firm receiving this circular (No. 1) will, at the earliest possible moment, indicate, as nearly as may be, his or their intentions with reference to being represented at this Exposition, the probable extent and character of the exhibit, the least amount of space that could be used to properly present it, and the greatest amount that could be advantageously used provided it could be had. As soon as these replies have been received, a diagram of the Exposition buildings, showing amount and character of space to be assigned will be sent to all parties desiring to exhibit, together with necessary blanks on which to make application.

An admission fee will be charged visitors, thus relieving exhibitors of the necessity of providing for the expenses of the Exposition.

It is believed that an exhibit can be organized which, in its benefit to the more intelligent masses, and especially to officers and employés in the railway service, and all who are interested in the manufacture of railway appliances, and as a contribution to the world's store of technical and practical knowledge, has never been equaled.

To this end it is earnestly hoped that every one who is directly or indirectly interested in supplying railroads, either with material or manufactured articles, will interest himself in this matter, and that every deserving article properly coming under the head of railway appliances may be creditably represented at this exposition.

All correspondence should be addressed to the Secretary.

COMMISSIONERS.

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E. H. Talbott, President and Manager of *The Railway Age*, Chicago.

Executive Committee.—Hon. Lucius Fairchild, H. E. Sargent, A. G. Darwin, J. McGregor Adams, E. V. Cherry, E. H. Talbott.

GAS AT PARIS.—The revenue of the Parisian Company for lighting and heating by gas in the first eight months of this year amounted to £1,672,635. The corresponding revenue collected in the corresponding period of 1881 was £1,544,237, showing an increase of £128,398, or 8.31 per cent. this year.

RAILWAY MATERIAL IN GERMANY.—It is stated that the construction of railway material in Germany absorbs nearly one-third of the iron and steel production of that country. This is in a great measure due to the considerable development of the foreign trade, especially in rails. In 1870, only 36,000 tons of German rails were purchased by foreigners; but in 1881 the exports amounted to 250,700 tons. These were purchased by Holland, the United States, Spain, Belgium, Switzerland, and India.

TRUSS BRIDGES.

AN ILLUSTRATED HISTORICAL DESCRIPTION OF ALL EXPIRED PATENTS ON TRUSS BRIDGES, WHICH UNDER THE LAW ARE NOW PUBLIC PROPERTY AND FREE TO BE USED BY ANY ONE.

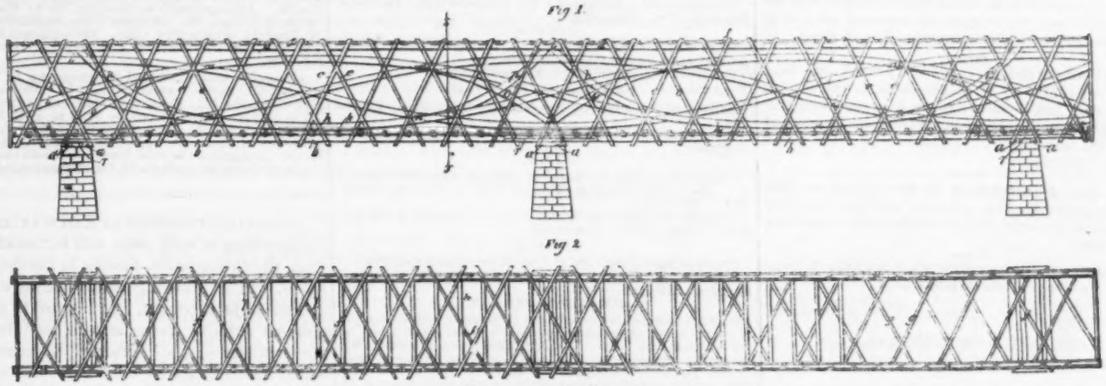
By F. B. Brock, Patent Attorney, Washington, D. C.

Jan. 7, 1851, Cunningham M. Pennington, of Georgia, devised an improvement in truss bridges.

Fig. 1 is a side elevation and Fig. 2 a plan with portions of the upper cross bracing removed to exhibit the lower braces, etc. *a* are the bearing timbers, upon which are arranged the lower chords *b*. The upper chords *d* are secured to the lower by side cross braces *e*, bottom cross braces *g*, and top bracing *f*.

The arches *i*, which are made of plank put together flatwise and sprung into the required curve of the arch while in course of erection, are continuous throughout the several spans of the bridge, and are so arranged that they shall be alternately the upright and inverted arch. One set of arches, moreover, change from upright to inverted over the piers, whilst the other set change midway of the span. Directly over the crossing points of one set of arches the other set are at their remotest distance from the first, and at their strongest sustaining points.

Thus constructed, there are two inverted and two upright arches in every portion of the bridge, so arranged that, whilst one set are approaching each other to change their direction at the crossing points where they are weakest, the other set is in position with regard to them at their strongest sustaining point, thus distributing the weight over the bridge evenly, and preventing any cramping up in advance of or sinking below any heavy weight which may come upon the bridge.



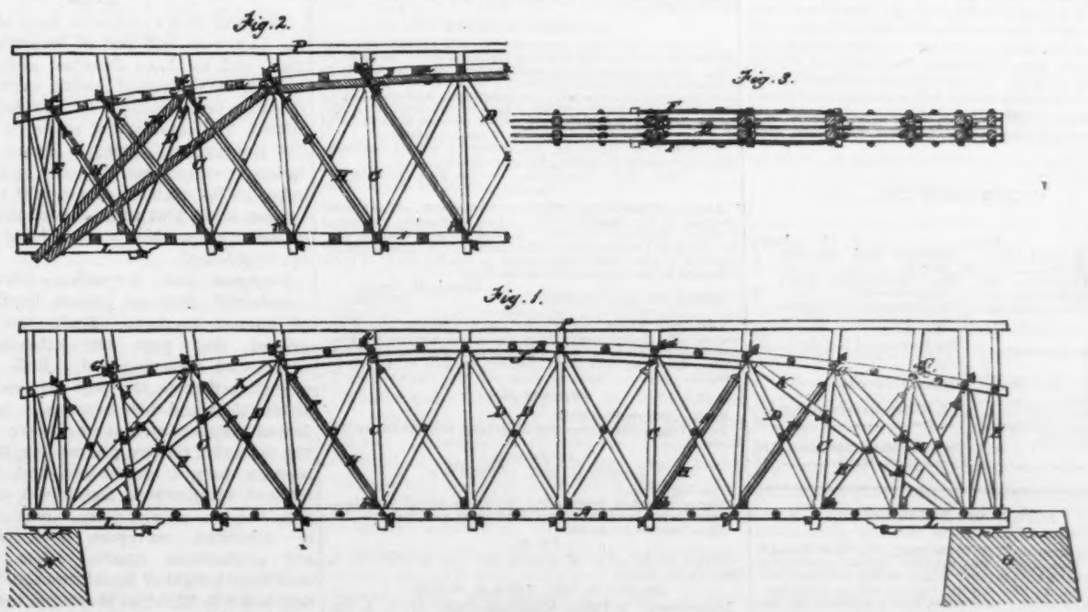
PENNINGTON'S BRIDGE.

July 15, 1851, D. C. McCallum received protection for a truss bridge. His invention consists in a method of lengthening or shortening the counter braces whereby any downward vertical stream or deflection can be maintained upon the girders.

A is the lower chord of the girder and *B* the upper chord. Posts *C* connect the chords and form radii to the upper one. *D* are thrust braces. *F G* are inclined ties or tension rods. Each of the tension rods *G* is encased by a counter brace *H*, the lower end of which abuts on a step *b* on the lower chord at the foot of the posts *C*, and its upper end fitted to a metallic sheath *I*. The tension rods pass under clamping pieces *c* under the lower chord.

J is an arched beam. It extends from the crown of the arch about half way to the ends. *K K* are inclined struts secured by bolts *f* to the posts, and pass through the lower chords and the bolsters *L* and rest in seats on the top of the abutments. *M* are other inclined struts resting against steps *g* under chord *B*.

The counter brace *H* which come in the way of the inclined struts are in pieces, and notched into them. The tension rods also pass through them. *P* are the roadway bearers supported on top of the posts *C*, which are continued above the upper chord.



McCALLUM'S BRIDGE.

(TO BE CONTINUED.)

ENGINEERING NEWS

AND

AMERICAN CONTRACT JOURNAL.

Tribune Building, New York City.

GEO. H. FROST.....EDITOR AND PROPRIETOR.
S. D. V. BURR, A. M. ....ASSOCIATE EDITOR.

SATURDAY, JANUARY 6, 1883.

EDITORIAL ANNOUNCEMENTS.

Terms of Subscription.—To the United States and Canada, $4 per annum, including postage; all parts of Europe, $5, payable in advance. Remittances at the risk of the subscriber, unless made by registered letter or by draft, check or P. O. order, payable to GEO. H. FROST.

Terms of Advertising.—One inch, 12 lines, one insertion, $2; one month, $6.50; three months, $17; six months $30; one year, $50. Special rate for large space and long time will be given on application. Advertisements inserted for less than three months, payable in advance; for longer time, payable quarterly.

Articles for Publication in the current number should be received at the office of publication not later than Thursday morning, and advertisements not later than Friday noon.

Correspondence upon subjects which naturally belongs to the province of this journal is solicited.

CLUBBING ARRANGEMENTS.

1883.

In order to accomodate such of our subscribers as may wish to subscribe for other periodicals we offer the following terms: We will send to any address ENGINEERING NEWS at regular subscription price, $4.00, and the following at the additional prices given:

	Net Price.	Reg. Price.
Atlantic Monthly	$3.25	$4.00
Century Magazine	3.55	4.00
Harper's Magazine	3.25	4.00
Harper's Weekly	3.25	4.00
Harper's Bazar	3.25	4.00
Harper's Young People (weekly)	1.25	1.50
St. Nicholas Magazine	2.55	3.00
North American Review	4.00	5 00
Our Continent	3.25	4.00

The principal change in the above figures from those of last season is in that of the *Century Magazine*, which has advanced its trade price correspondingly. Our purpose is to bring the trade of our subscribers into this office, and to do his we give the clubbing journals at trade price and we add five cents to pay for stamps, stationery and time in handling the business. We wish it understood that we will extend this arrangement to any desired journal in the United States, so that our subscribers need not pay any attention to the claims of solicitors, who cannot offer any better terms.

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NOTICE OF MEETINGS.

AMERICAN SOCIETY OF CIVIL ENGINEERS, 127 East Twenty-third street, New York. The thirtieth annual meeting of the society will be held in New York, on Wednesday, Jan. 17, 1883, at 10 A. M. The annual reports will be presented, officers for the ensuing year elected, time and place for the next annual convention considered, proposed amendments to the constitution discussed, and other business transacted. Arrangements for Jan. 17 and 18 will be perfected by a committee, and you are invited to be present at the meetings on those days.

COUNTY SURVEYORS' ASSOCIATION OF INDIANA.—The annual meeting of the association will be held at the County Surveyor's office, in the Court House, at Indianapolis, beginning on the 16th of January, 1883. Addresses on different subjects in regard to surveys, ditches and gravel roads are expected to be delivered, which will be of interest to the Indiana surveyers. An interesting meeting is expected.

HERVEY B. FATOUT,
Corresponding Sec'y.

THE MICHIGAN ASSOCIATION OF SURVEYORS AND ENGINEERS—The Fourth annual meeting of the above association will be held at the State Capital, Lansing, Michigan, on January 9-12, 1883

PROGRAMME.

TUESDAY, JAN. 9.—2. P. M.

Association called to order. Reading of minutes. Committee to examine surveyors' instruments appointed.

3 P. M.

Legislative needs of our profession.—Paper by George E. Steele, Grand Traverse. General discussion.

7.30 P. M.

Address of President, Prof. C. E. Greene of Ann Arbor. General discussion.

Construction and care of our common roads; by Burton Kent of Adrian. General discussion.

WEDNESDAY, JAN. 10.—9 A. M.

Difficulties in city surveying.—A. J. Teed, City Engineer, Cadillac. Discussion.

Construction and care of water-works suitable for small cities in Michigan.—Chas. B. Hyde, City Engineer, Jackson.

2 P. M.

Method of projecting parallels of latitude.—H. C Pear sons, U. S. Inspector of Steam Vessels, Ferrysburg. Discussion.

Questions in practice.—I. H. Leavenworth, Engineer, Saginaw City. Discussion.

7.30 P. M.

Surveying instruments.—Prof. J. B. Davis, Ann Arbor. Remarks by manufacturers and others.

Report of Committee on Instrument Exhibit.

THURSDAY, JAN. 11.—9 A. M.

Reports of committees.—The manual; legislation. Discussion.

Railroading in Utah.—Frank Hodgman, Engineer, Climax Discussion.

2 P. M.

Construction and operation of narrow-gauge railroads.—A. L. Reed, Chief Engineer P. H. & N.W. R. R., Port Huron, Mich. Discussion.

Logging railroads of Michigan.—E. F. Guild, Engineer, East Saginaw, Mich. Discussion.

7.30 P. M.

Traverse surveying.—Prof. J. B. Davis, Ann Arbor, Mich.

Engineering of town and county drains.—S. N. Beden, Engineer, Pine Run.

QUESTIONS OF PRACTICE.

In order to avoid waste of time it is important that such questions be arranged and given some consideration before our next meeting. Mr. I. H. Leavenworth, of Saginaw City has kindly undertaken this task. It is to be hoped that enough queries will be submitted to cover most of the difficult points in practice Questions on which the opinion of the Association is desired should be sent at once to Mr. Leavenworth or the Secretary.

EXHIBIT OF SURVEYING INSTRUMENTS.

By a special vote of the members at the last meeting an exhibit of surveying instruments will be held at our coming meeting. We invite each member to exhibit his instrument of practice, whether good or poor, and shall provide proper place for such an exhibit. We especially invite manufacturers to exhibit instruments of their own make. If they can attend our meeting personally, we offer them a place on our programme. To our members we will say that we hope to induce one or two of the most noted manufacturers to be present with us.

ENTERTAINMENTS.

The hotels in Lansing will give the following rates to members of the Association:

Lansing House	$2.00 per day.
Hudson House	2.00 "
Chapman House	1.25 "
Goodrich House	1.25 "
Everett House	1.00 "

INDUCEMENTS TO ATTEND.

Each member of the association should arrange his work so that he can be in attendance throughout the whole meeting. The advantages to be attained may be stated briefly as follows: Mutual instruction, which in time will be evident in a more uniform practice; acquaintance and good feeling toward fellow laborers, which cannot be estimated in money; an opportunity, at small expense, to see the attractions of the State capital during a session of the Legislature.

Surveyors or engineers, not members, should embrace this opportunity for joining the association.

PROF. H. C. CARPENTER, Lansing, Mich., Secretary.

AMERICAN INSTITUTE OF MINING ENGINEERS.—The annual meeting of the Institute will be held in Boston, beginning Tuesday, February 20, 1883. A subsequent notice will give the detailed programme of the meeting. Members are requested to give early information to the Secretary of their intention to read papers at this meeting.

THOMAS M. DROWN,
EASTON, Pa., Dec. 27, 1882. Secretary.

THE OHIO STATE ASSOCIATION OF SURVEYORS AND ENGINEERS.—The fourth annual meeting of the Surveyors' Association of the State of Ohio will be held in the Board of Trade rooms, City Hall building, Columbus, O., Jan. 17, 18 and 19, 1883.

OFFICERS, 1882.

Fred. J. Sager, President.
Benj. Thompson, Recording Secretary and Treasurer, Urbana, O.

PROGRAMME.

January 17, 1883, 2:30 to 5 p. m.

Opening address.
Annual report of Secretaries, Treasurer and Committees.
Discussion—Subject: New Constitution and By-Laws.
Miscellaneous Business.

8 p. m.

History of the office of County Surveyor in Ohio, R. S. Paul, C. E., Akron.

January 18, 1883, 9:30 a. m. to 12 m.

Improvement in Public Highways—Paper by S. A. Buchanan, C. E., Bellefontaine.

Discussion—Subject: Laws Regulating the Laying Out and Improvement of Public Highways and Ditches and Suggestions for their improvement.

Miscellaneous Business.

2 to 4:30 p. m.

Report of Standing Committee on Legislation.

Discussion—Subject: General Laws Referring to the Duties of Surveyors and Engineers.

8 p. m.

Sub-Division of Land in the State of Ohio, as made by the General Government—Paper by R. W. McFarland, Professor of Mathematics and Civil Engineering, Ohio State University.

January 19, 1883, 9:30 a. m., to 12 m.

Sanitary Engineering—Paper by J. B. Strawn, C. E., Salem.

Discussion—Subject: Instruments and their Use, Measures, Magnetic Needle, Meridians, Field Books, Records, etc.

1:30 to 2:30 p. m.

Miscellaneous Business.
Annual Election of Officers.
Adjournment.

ILLINOIS TILE MAKERS' ASSOCIATION.—The fifth annual meeting of the Association will be held at the State House, Springfield, January 16 and 17, 1883:

PROGRAMME.

Tuesday, 10 *o'clock a. m., January* 16.—Address of Welcome by Gov. S. M. Cullom. Roll Call. Reading Minutes of last Meeting. Reports from Members as to the interest in Tile Drainage in their respective localities.

Afternoon Session.—Receiving Reports of Officers. Benefits of Farm Drainage, by Prof. Geo. E. Morrow, Illinois Industrial University. Discussion. Clays and their Management, by Prof. G. S. Tiffany Tecumseh, Minn. Discussion.

Evening Session.—Kilns—Construction and their Management, by J. E. Landrum, Hebron, Ohio. Discussion. Question Box.

Wednesday Morning.—Sanitary Influence of Drainage, by John H. Rauch, M. D., Secretary Illinois State Board of Health. Arrangements for making Tile in Winter—A. Horrocks, Bardolph, Ill. Roofing Tile—Manufacture of, by J. W. Penfield, Willoughby, Ohio. Difficulties in Making Large Tile, and how Obviated, by Alex. Huey, Dwight, Ill. Question Box.

Afternoon Session.—Road Drainage, by S. T. K. Prime, Dwight, Ill. Improvement of Soil by Drainage, by C. G. Elliott, Tonica, Ill. Election of Officers. Adjournment.

Tile makers are requested to send to S. D. Fisher, Secretary State Board of Agriculture, the names and post-office addresses of all the tile makers in the county in which they reside. Arrangements have been made with the leading railroads centering in Springfield, for reduced rates.

NATIONAL EXPOSITION OF RAILWAY APPLIANCES.—Elsewhere in this issue will be found a circular from the Commission having in charge this exposition, which gives a general outline of the plan and the objects sought. In regard to railway appliances arriving from abroad and destined for the exhibition, the Treasury Department has issued instructions to collectors and other customs officers, that such appliances may be shipped by bonded common carriers from the port of arrival to Chicago. Upon their arrival the goods will be taken charge of by the collector of customs, and the usual entry for warehouse will be required. After bonding of the Exposition building an appraisement will be made, and the rate and amount of duties determined. Details of the method of storage and the requirements in case of sale of any of the goods are provided for.

REVIEW OF THE PAST YEAR'S WORK.

We think that a review of some of the work of the past year will not be inappropriate at this time, and we have therefore grouped together some of the subjects of leading engineering topics that have been published in the volume just completed. The information conveyed in a journal like ENGINEERING NEWS is drawn from a great variety of sources, and it is only by a study of the index to its contents, or a careful review of the volume itself, that a fair idea of the vast variety of information which a year's labor accumulates can be obtained.

Surveyors and Surveying.—Surveyors have complained that we publish hardly anything of interest to them. Really this is the only journal that pays any attention to surveyors and surveying, and a little examination will show that in the past year we have not neglected them and their interests. It is with a good deal of satisfaction that we observe the progress the surveying fraternity is making, through their recently formed associations, and if the same rates of excellence is maintained, as it probably will be, a few years only will give to American surveyors a social, political and professional standing that would not have been thought of some years ago. "Attempted Legislation in Michigan in relation to surveys" was an initial effort of the Michigan Association of Surveyors and Civil Engineers to organize the surveying service of that State; to secure uniformity of practice; the use of a standard measure; and a more complete recording of surveys of a permanent nature. A bill was introduced into the State Senate where it was passed without amendment and with little opposition. In the House, however, it was reported adversely on and summarily defeated. The bill and the adverse report are of interest as indicating the different views of surveyors and lawyers, the latter dis-

secting in the most cold-blooded manner the collective wisdom of the former, exposing the ignorance of the average surveyor of the State laws governing surveys, but yet clearing the way for the surveyors who may attempt still further legislation. How the State Line survey between Pennsylvania and Ohio is monumented is told in an early number of the volume. In an article on "Probable Error," Prof. Mansfield Merriman, of Lehigh University, a most accomplished mathematician and surveyor, discusses the comparative values of repeated readings on the theodolite and transit which cannot fail to interest every thoughtful member of the profession, while Mr. H. C. Pearsons explains an easy method of measuring inaccessible distances. Stadia surveying is treated at length in an able article by U. S. Asst. Engineer, Jas. P. Allen, who gives not only theory but practical application, which is supplemented by articles from Mr. Geo. Morton, of Sandusky, and Mr. Ockerson of the U. S. Lake Surveys, on this valuable method of surveying while R. I. Morrison, C. E., furnishes some simple rules for field practice on "Random Lines," and supplies what no hitherto published work has given. In an address at the second annual meeting of the Indiana County Surveyors, the Hon. David Turpie defines land-surveying and its four divisions; gives a short history of it; mentions the instruments, and then gives at length some very valuable legal memoranda relating to surveys; a New Meridian finder is illustrated on Page 183. The meetings and proceedings of the surveyors societies in Michigan, Indiana and Ohio are recorded at length; how to draw a Meridian line is shown by R. W. McFarland, an Ohio surveyor on Page 224, and Fred. Howell of the same State gives a minute description of the office of County Surveyor with much valuable memoranda relating to practical land surveying.

Prof. Prunpelly's extensive land survey for the Northern Pacific and Oregon Railway and Navigation Companies is of interest as being the account of about as large a private survey as is now in progress in this country; while the most valuable paper on practical hydrographical surveying that has appeared in any publication is that of A. C. Both, C. E., of Portland, Me., prepared expressly for this journal; a boat survey, or reconnoisance of some Florida rivers, is described in a very interesting way by Ass't U. S. Engineer, J. F. LeBaron, and hydrographical work, in field and office, is further described on the following page.

"Early American Books on Surveying" is editorially treated on page 382, while further on, triangulation stations forms the subject of editorial comment. There is also a considerable amount of information relating directly to surveying, embodied in other and collateral subjects, which will be appreciated by every intelligent surveyor. Among these we may specify the exhaustive correspondence of Mr. Chas. H. Swan and others on the metric chain and its use. Mr. Swan has also treated so very fully on other applications of the metric system, that in the pages of ENGINEERING NEWS for the past year, we venture to say, one of the simplest and most comprehensive expositions of that system ever published may be found, and, it is certain, that these letters of Mr. Swan will be constantly referred to for information on the system of which he is so intelligent and zealous an advocate.

Engineering Societies.—We have reported in full the proceedings of all that we could reach, and wishing to make this a feature of our paper, we believe we have included all the most important ones in the United states and England, and by having special translations made for us of the doings of the Continental Engineering Societies, we have been enabled to give our readers a general resumé of the world's practice, as far as it comes within our domain as an engineering newspaper. We wish to extend this feature, to embrace as wide a field as possible; we want to give you *all* the "engineering news" of the day, whether embodied in extracts from the Transactions of Societies, or gathered from other sources, and to this end shall especially exert ourselves during the coming year.

Bridges.—In our land of broad water-ways, requiring frequent and long-span bridges, the description of completed structures, and the discussion of methods, acccepted and proposed, must necessarily occupy much space in any publication devoted to recording engineering progress. In addition to noting the general construction of such bridges as form links in our daily growing railway system, we have presented to our readers in the past year, much original matter kindred to this subject. This includes papers on Highway Bridges and Railroad Girders, description of the method of driving piles on ground too soft to carry a piling machine, as followed in the building of a Trestle bridge over McCoy's Creek, in Florida; the effect of wind pressure on structures, as discussed by our correspondents, and the temporary bracing necessary for replacing chord bars in bridges. The table for computing rapidly the net and gross sections of angles, and the allowable strain, will be found useful to bridge and roof designers. The testing of materials and riveted and forged members, and our advance in exact knowledge must have a most important bearing on the "bridge of the future," in this connection the article of Mr. Theo. Cooper, on "Testing and Testing Machines" is most timely and valuable, coming as it does from one who has had long and varied professional experience. This is a subject upon which too much can not be said, and one whose importance to engineers, Congress is only too slow to appreciate, judging from the lack of appropriations to utilize the magnificent machine now practically rusting at Watertown. The contributions of Mr. Brock, of Washington, on Truss Bridges, as recorded in the U. S. Patent Office, are worthy of note, as illustrating the successive steps by which bridge-builders, within the century, have advanced from the wooden truss of Burr, and the plank lattice of Towne, to the noble structures of steel and iron now spanning the Mississippi, the Ohio, and the East River. Many of the designs seem absurd to us now, in our later light, but they are no less instructive, as links in the chain of engineering progress, and will repay study.

Tunnels.—Under this heading the Tunnel under the Hudson River, has naturally received more of our attention than any other; both from the fact of its importance, as a commercial factor to the City of New York, and that it is at our very door. Both by illustrations, and careful description, we have attempted to make our pages a source of future reference, as to the methods pursued, and the work actually done; we shall continue to closely watch and note its future progress. Within the year, the Dorchester Bay Tunnel, in Boston, was completed; and in our columns will be found an illustrated paper describing the difficulties, our neighboring city has overcome in her bold, but laudable attempt to get rid of sewage matter. The Weehawken Tunnel, in New Jersey, and the Rockport tunnel, on the line of the Lehigh R. R., are both noted, accompanied by plans and cross section. Outside the borders of the U. S. the St. Gothard is described in detail, the Channel Tunnel, and that proposed, under the St. Lawrence at Montreal, are with others on a smaller scale, duly mentioned.

Railroads.—With about 116,000 miles of main, second, and side track already in operation in the United States, this subject is lengthy in more senses than one. We have endeavored to keep our readers posted, not only by noting the advent of new roads, and the doings of those already established, but by also presenting any data interesting or instructive to the builder of railroads, either in the form of published correspondence, or in articles more elaborate. In this connection we would invite the attention of the engineering profession to the real merit of these "letters," as a means of an interchange of opinions on work actually in hand. Any engineer can write a letter, detailing experience in some special work, even if he had neither time nor inclination to publish an elaborate paper and the oft-times valuable data thus put on record, would otherwise never find its way into print, to be utilized by his brethren. Results which spring from the hard-fisted necessity of the case, or from knowledge gained by practical experience, are often worth more to the profession, than the opinions of perhaps more learned men, but men who also lack the leaven that only actual practice can give.

In the past year we have printed correspondence, upon the grading and alignment of railroads, the adjustment of grades to curves, the staking out of switches and the calculation of frog distances and angles, on over-haul, the spiral curve, the metric system on railroads, and general earthwork calculations. The diagram of "average heights," by Wm. F. Shunk, the well-known author of "The Engineers' Pocket Book," and the "Correction Table" for Earthworks on lateral sloping ground, by M. Weber, are both new and useful, and appear for the first time in our columns. Mr. William F. Johnson presents a most excellent original paper on "Rapid Track-laying in Texas," entering into all the details of the organization of the army of laborers, required "to lay two miles of railroad track per day." This feat, not now an uncommon one, is in itself but a type of our engineering progress, and taking this rapid growth of track in connection with the modern locomotive, with its seven-feet driving wheels, capable of hauling a train 90 miles in 80 minutes, we can not but wish that good old Dr. Lardner could stand by, and realize what railroads really mean in this "rapid age." Scarce fifty years have past since this perhaps most learned man of his time gravely testified that the fast horse of his day need fear no rival in his iron brother, that from his deductions a train on metal rails could not possibly exceed a speed of ten miles per hour.

The advances made in the introduction of electric light, steam heating, and rapid transit by elevated roads, in the larger cities and towns throughout the United States, have all been duly mentioned, as coming within the province of an engineering newspaper; the education of engineers, as relating to the training of youth, has received attention, and, as far as was possible, we have given the personal movements of the engineering officials of the country; though we must confess, that as a class, they are somewhat difficult to keep track of. We might insert a query here, and ask, "Why is it, that while we find English, French and German engineers in every land, from South America to Japan, so few Americans seek professional fame and fortune outside the borders of the United States?" Is it that our land is so wide, and the extension of our own public works so rapid, that we can spare no man from the ranks of his profession? We certainly cannot accuse them of lack of sufficient enterprise, for the "Yankee" has made himself felt in other professions, under every sun. We leave it to some wiser head than ours to answer.

Sewerage.—Our large cities and towns, and it is often just as necessary in the smaller ones, are just awakening to the vast importance of sanitary engineering, and its bearing on the coming race. Slip-shod methods of removing sewage, have heretofore prevailed, or it has not been removed at all, being suffered rather to breed disease by saturating the soil under and around our very homes. But compelled to action by epidemic fevers, increased death rate, and, perhaps, by personal danger, the engineer has at last stepped in and by a careful study of cause as coupled with effect, has turned all the engines of modern science upon the foul and death-dealing monster. Day by day our knowledge increases, and now some of our very ablest engineers, are devoting all their time and knowledge to the consideration of this subject, and one of our best conducted technical journals is published solely in the interest of sanitary engineering. While it is not within our province to enter too fully into the detail of such matters, still, as far as it relates to "engineering news," we mean to publish the advent of all new

works, as well as those proposed, or the discovery or invention of any new method or machine.

Water-works.—Perhaps some of our readers, who are not personally interested, may think that we have given them too much water during the past year. But it is a subject in which we are all interested, more or less directly, and upon a little reflection we think the subscribers to whom we refer above will realize the true and great value of this collection of statistics, to which Mr. Croes has devoted so much precious time and patient labor, and to which we have given considerable space. We must consider that the works now in operation in the United States number nearly 700, and that this number is almost daily growing, as town after town begins to realize the necessity of pure water, or are forced to build, by exhaustion or contamination of existing supplies. To the impatient reader, we say, wait but a little longer and this publication of data will cease in our pages, to reappear in book form; a book which will present the only complete collection of "American Water-works," properly arranged and tabulated. The designer and builder of water-works can appreciate the exceeding value of such a gathering together of data, as a means of comparison of methods, first cost, running expenses and results gained, and to the commercial world, as relating to insurance and supply of material, it must be acceptable as well.

THE PANAMA CANAL.

Mr. Chas. Colnè, Secretary of the American Commission of the Inter-oceanic Canal Co., delivered a lecture at Steinway Hall on Jan. 4 on the present status of the Panama Canal. The lecture was most interesting and instructive, as throwing much light upon a subject little known in the United States, and about which so many seemingly false reports have been spread abroad by parties interested in parallel schemes. Mr. Colnè commenced with an historical account of the many plans devised for uniting the two oceans in this neighborhood, from that of Balboa in 1513 to the present undertaking of M. de Lesseps, showing that the present proposed canal occupies the old Spanish trail, by which the treasures of Peru were at one time transferred from Panama to the old ports of Chagres and Porto Bello.

He denied the prevalent rumors as to the extreme unhealthfulness of the Isthmus, saying that the thermometer ranges between 95° and 59° Fahr., that the atmosphere, being saturated with moisture, requires certain precautions on the part of the stranger, but by taking these precautions and abstaining from stimulants, a man was in little danger. In proving the fallacy of the old story about the death-rate on the Panama Railroad of "a dead man to every tie," he demonstrated that each workman engaged in the construction of that road would have had to die about four times to fill the conditions of this wild statement.

In the Panama canal, as now located, there will be about 90,000,000 yds. of excavation. The material is chiefly clay and soft mud, though in certain sections volcanic rock is found, very hard, ten feet below its surface. Of this amount of work, 26,000,000 yds. is already contracted for. The cuts will be 490 ft. wide at the water surface in the lower portions of the canal, 72 ft. wide in the deep cuttings; depth of water, 28 ft. at mean tide; the sidings for the passing of vessels occur at intervals of from 6,500 ft. to 9,700 ft. The damming of the Chagres River, about which so much has been said by the unfriendly, presents no serious difficulties to the canal engineers. Rock and waste material abound, and they propose with this to build a dam 130 ft. high and 3,300 ft. wide at base, and if caught by floods during its construction, to simply put more material in the room of that carried away; the basin above the dam, Mr. Colnè says, is ample to contain the waters of the greatest recorded flood. The work of excavating and removing material is to be done as much as possible by labor-saving machinery, and this will be mainly of American design and construction. To a point 12 ft. above the water line, the cutting will be done by steam excavators; below that line by the most powerful dredges ever built. One of these latter, now being built in Philadelphia, will handle 15,000 cubic yds. per day; by a system of buckets attached to an endless chain, the excavated material is raised 60 ft. above the water level and thence carried on shore by means of chutes assisted by astream of water, thus making its own bank without further handling. This dredge will excavate to a depth of 30 ft., and deposit material to a height of 40 ft. The system is the same as that used in the dredges employed in building the Suez Canal, but the largest of these latter only handled 2000 cu. yds. per day. Mr. Colnè referred at length to the mooted question of the influence on the working of the canal, of the varying tides of the Pacific and the Atlantic, the difference in rise being 18 ft. It was at first proposed to overcome this by an elaborate and expensive tidal lock, but in the light of later investigation and reasoning, M. De Lesseps has decided to abandon this scheme, and thus save over $2,000,000.

The Canal Co. have already erected many houses, shops, hospitals, warehouses, railroads, etc., have bought an immense quantity of plant and materials, buying $1,600,000 worth of this, in the U. S., in the shape of machines, tools, iron, and hard-pine lumber. Their main depot of supplies will be at Gatun. Already much work has been done on the landing and entrance in the Bay of Limon.

In regard to funds, Mr. Colnè, says, the first loan called was for $60,000,000, this was subscribed for four times; the second loan of $25,000,000, which was mainly devoted to the purchase of the Panama Rail Road, a necessity to the Canal Co., was three times subscribed for, proving as Mr. Colnè expressed it; either that the French were a very gullible nation, or what is nearer true that they had an abiding faith in the success of the undertaking of de Lesseps; M. de Lesseps himself though now in his 75th year, says the canal will be opened to the world's traffic in 1888, and that he will live to see it. Mr. Colnè concluded his lecture by referring rather sharply to his neighbors, who propose a canal via Nicaragua, explaining that the 17 hours gained in sailing time was rather more than offset by the delays and dangers attending the passage of the modern ocean steamer, through 177 miles of inland waters, obstructed at certain points by a series of locks; he referred to the danger either to ship or masonry of the entrance into the locks, the result of the sinking of a vessel in the lock, and the enormous expense attending the construction of a new port of entry.

THE AMERICAN SOCIETY OF CIVIL ENGINEERS.

The first meeting of the society in the New Year was most propitious. There was an unusually large attendance of members and visitors, many of each being men connected with the largest and most important enterprises in the country. Among these we noted Mr. Fisher, Chief Engineer N. Y. C. & H. R. R. R., and Mr. Chanute, Chief Engineer of the Erie Railway, and E. P. North, of the Sinaloa & Durango Railroad; the bridge-building interests were represented by Messrs. Charles Macdonald, Theodore Cooper, L. L. Buck, William H. Paine, J. McNulty and H. Constable; F. C. Prindle, from the U. S. Navy, was present; steam heating had its exponents in the persons of Messrs. Wm. P. Shinn and C. E. Emery; the Dock Department of New York was there in its past and present Chief Engineers, Messrs. George S. Greene, Sr. and Jr.; the telephones and telegraphs were represented by the distinguished Vice-President and Chief Engineer of the leading company in the country, Mr. Joseph P. Davis, formerly City Engineer of Boston. We noted also as present Messrs. W. O. Hamilton, President of the Ramapo Wheel Works and the well-known author of "Useful Information for Engineers;" F. O. Norton, who is a very active and interested member of the society, and who has recently completed his new cement works at Roundout, N. Y.; E. F. Andrews, the enthusiastic and persistent foe of the enterprising teredo, and who has recently concentrated his creosoting works at Norfolk, Va.; S. S. Haight, who is the representative accurate land surveyor, and who is a most zealous member of the society; Messrs. Hering and Stauffer, new comers from the Quaker City, but old acquaintances in the profession that can lay no claims to being local; Mr. C. Constable, from Constableville, N. Y., was present; Cook Talcott, of New Jersey; Mr. Harris, of Brooklyn, and brother; Mr. Baker, of the Canada Pacific Ry.; journalism was ably represented by Mr. M. N. Forney, of the *Railroad Gazette*.

The rooms of the Society are overflowing with books, periodicals, maps, photographs, line drawings and models, of engineering literature, works and structures. They are brilliantly lighted and agreeably heated on all occasions of evening meetings. There are numerous opportunities for conversation and acquaintance with leading men in the profession. A feeling of good fellowship usually prevails along with the usual grave demeanor that seems natural to engineers. The papers are usually discussed in a conversational style, and if members of the society generally knew what pleasant and profitable evenings can be spent at the society rooms, they would make an effort to be present.

The chair was occupied by Vice-President Paine, and Secretary Bogart was in attendance to look after the routine business of the meeting. The following were elected:

FOR MEMBERS:

HIEL HAMILTON FILLEY, Division Engineer, Mexican National Construction Co. Mexico, Mexico.

ARTHUR J. FRITH, U. S. Ass't Engineer, Hotchkiss, Tenn.

JOSEPH PALMER FRIZELL, Civil Engineer, St. Paul, Minn.

GEORGE HERNDON PEGRAM (elected Junior, April 7th, 1880), Engineer Bridges and Buildings, Edgemoor Iron Co.

FOR JUNIOR:

CHARLES FREDERICK LOWETH, Engineer with Raymond and Campbell, Bridge Builders, Council Bluffs, Iowa.

Mr. Wm. P. Shinn read a paper on "Railroad Economics" as a Pseudo Science, in which he criticised very severely Van Nostrand's Science Series No. 59. The principal subject of the criticism was the cost of stopping a railway train, in the calculations of which Mr. Robinson, author of "Railroad Economics," goes into a wonderful array of figures to get at this cost. Mr. Robinson makes this figure $1.28 as the cost of a single stoppage of a train on an Ohio railway. In the discussion which followed Mr. Chanute quoted sworn statements in court trials upon crossings that the minimum he had any knowledge of was one-quarter of a cent, and the maximum two dollars. The Pennsylvania Railroad Company placed the cost roughly at 50 cents per stoppage, but allowed that the true cost cannot be arrived at. Mr. Shinn's paper is published in full in the *Railroad Gazette* of this week, as it was originally written for that journal, but was afterwards contributed to the society.

The programme for the annual meeting was partially outlined by the secretary, but nothing definite enough was given to warrant publication.

PERSONAL.

JOHN WATSON, Chief Engineer of the Cunard steamer Servia, died in England on the 20th ult. He had been 40 years in the service of the Cunard Company.

Chief Commissioner of Highways, WILLIAM BALDWIN, of Philadelphia, died suddenly at about 10 o'clock on the morning of the 1st inst., of heart disease.

Mr. JOHN WADDLE died last week in Chillicothe, O. He was formerly Chief Engineer of the Marietta & Cincinnati, had been for many years a director and lately President of the company.

STEPHEN L. JENNINGS, Superintendent of the Brooklyn City Railroad Company, died on the 4th

of blood poisoning which followed sciatica, resulting from a cold incurred last February. He had suffered intensely, and for three months his life had been prolonged by the use of morphine.

W. R. GERHARD, Civil Engineer, of Newport, R. I., who has been assistant to Col. GEO. E. WARING and to the Drainage Construction Company, of Boston, has resigned his position and accepted one of Superintending Engineer for the Durham House Drainage Company, with headquarters in New York City.

MR. W. R. MORLEY, Chief Engineer of the Mexican Central Railway, is reported by a telegram from Chihuahua, Mexico, to have been accidentally shot and killed at Santa Rosalia, Mexico, on Jan. 3. Mr. Morley was a member of the American society of Civil Engineers, and has been engaged on roads west of the Mississippi during most of his professional life. He became well

CANADA PACIFIC R. R.—Rumors from Montreal state that C. J. Brydges, formerly manager of the Grand Trunk Railroad, has been appointed general manager of the Canadian Pacific Railroad, and that Mr. Van Horne will look after the construction.

DANVILLE (ILL.), OLNEY & OHIO RIVER R. R.—Charles Howard, of Boston, Mass., has been appointed receiver vice Jas. A. Eads, who has resigned. The bond is $25,000.

OHIO CENTRAL R. R.—It is said in Logansport railroad circles that George G. Hadley, assistant general manager of the Ohio Central, is to resign.

TEXAS & ST. LOUIS R. R.—G. W. Ristine, is appointed general manager of the Texas & St. Louis road.

DES MOINES, N. W. & WABASH (N. G.) R. R.—C. F. Meek has assumed control as superintendent

THE PHILADELPHIA WATER DEPARTMENT.

The following tabulated statement of receipts, expenditures, work done, etc., in the Philadelphia Water Department, will explain itself. This table comes to us from the Philadelphia Department as documentary evidence in further support of deductions made by ourselves from reports. We have compared it with these, and find it correct, and as being presented in a more complete and compact manner than we could, at this distance, compile it, we present it with pleasure, in simple justice to that too-uncommon official, an honest man. He has shown his ability and worth by his works, and yet, for reasons unknown to the general public, who are most interested, is still unappreciated by those who make and unmake heads of departments. We refer to Dr. Wm. H. McFadden, the present efficient Chief of the Philadelphia Water Department.

PHILADELPHIA WATER-WORKS.

Current Receipts.

From January, 1855, to January, 1873 (18 years), the revenue was $11,807,813.76.
The delinquent water rents for 18 years were $212,385.72
" " penalties " 18 " " 24,795.72
Total $237,181.44
In the year 1876 the collection for delinquent water rents amounted to $31,971 75
" " " 1877 a radical change in the clerical force increased them to 62,104.75
" " " 1878 after arrest and trial of defaulting clerks they amounted to 136,123.93
The total revenue in 1872 was $1,075,203.47
" " " 1881 " ..... 1,509,541.34 an increase of $434,337.87, or over 40 per cent.

From January, 1873, to January, 1882 (9 years), the revenue was $12,018,533.68.
The delinquent water rents for 9 years were $622,632.35
" " penalties " 9 " " 89,529.61
Total $712,159.96

Current Expenditures.

In 18 years expended a total of $9,129,779 85
" 9 " " " 7,400,157.70
Less expended in the nine years from 1873 to 1882 ..... $1,729,622.15

Pipes.

From January, 1855, to January, 1873, net tons of pipe handled 43,023
" " " " " " a yearly average of net tons 2,390

From January, 1873, to January, 1882, net tons of pipe handled 29,464
" " " " " " a yearly average of net tons 3,274
or nearly 40 per cent. greater. There being more pipe laid in these 9 years than in the 26 preceding consolidation and nearly 70 per cent. as many as during the 18 years preceeding 1873.

Pumpage.

From January, 1855, to 1873, the daily average pumpage was 26,000,000 gallons.

From January, 1873, to 1882, the daily average pumpage was 50,000,000 gallons.
This water was pumped, on an average, 20 per cent. higher than the 26 millions in the 18 years preceding.

The daily average pumpage in 1872 was 35,000,000 gallons.
" " " " 1881 was 62,000,000 "
an increase of 27,000,000 gallons daily pumpage, or about 80 per cent. increase of daily pumpage, to do which the work was increased 108 per cent.

From 1855 to 1873 the total maintenance $2,602,530.69
Million gallons 100 ft. high 197,297,635,256
From 1855 to 1873 the average cost per total maintenance to pump 1,000,000 gallons 100 ft. high was 13.64.
The total maintenance in 1872 was $204,107.12.
In 1872, at a daily average of 35 millions, the cost per million gallons, 100 ft. high, was $12.00 on the basis of total maintenance.

From 1873 to 1882 the total maintenance $2,709,033.37
Million gallons 100 ft. high 235,132,920.300
From 1873 to 1882 the average cost per total maintenance to pump 1,000,000 gallons, 100 ft. high was $11.52.
The total maintenance in 1881 was $326,465.68.
In 1881, at a daily average of 62 millions, the cost per million gallons, 100 ft. high, was $9.53 on the basis of total maintenance.

During the term of Chief Engineer McFadden there has been turned into the City Treasurer nearly five million dollars over and above all expenditures; an additional surplus of nearly one million dollars will be added for the year 1882, and the income has been *increased* 40 per cent., the pumpage 80 per cent., and the work over 108 per cent., while the expenditures have been *decreased* 45 per cent.

In the 36 years preceding consolidation the pipes handled, 29,097 tons or 58,195,359 pounds.
" " 18 " prior to January, 1873, " " 43,023 " 86,045,684 "
" " 9 " since " " " 29,464 " 58,927,937 "

To maintain 58,100,829 pounds of pipe on the ground laid previous to consolidation and the addition of 86,045,684 pounds of pipe handled during the 18 years prior to January, 1873, cost from appriations $2,134,306.92
Loans 1,581,828.02
3,716,134.94 an average of $6,683.09 for each of the 556 miles on the ground or per 100 pounds, $2.58

To maintain 140,538,077 pounds of pipe in the ground previous to 1873, and to add 58,927,937 pounds handled in the last nine years:
Lost from appropriations $2,029,013.20
Loans 645,996.37
Total ..... $2,675,009.57 an average of $3,543.05 for each of the 755 miles in the ground or per 100 pounds, $1.34

It required in the 18 years prior to 1873 over 77 per cent. of the receipts to meet all the expenditures, while in the *last nine years* it required but 61 per cent.

known as engineer of the Leadville Branch of the Atchinson, Topeka & Santa Fe Railroad during what was known as the "Cañon war." He had, previous to his appointment on the Mexican Central, just completed the Sonora Railroad. He had given special attention to the subject of compensating for curves on grades, and used his system in the location of the Sonora road it is said with great success in eliminating friction on such curves.

ELECTIONS AND APPOINTMENTS.

CHARLES S. DWIGHT, of Columbia, S. C., has been appointed Chief Engineer of the Augusta, Elberton & Chicago Railway, and will make the surveys and location at once. MR. DWIGHT has resigned the position of Chief Engineer of the Chester & Lenoir (N. Y.) Railway, which he has held for over five years.

GEORGIA CENTRAL R. R.—After the most exciting election in the history of this corporation, the following ticket was elected on the 1st inst.: W. G. Raoul, Andrew Low, Edward C. Anderson, J. Gresham, George Cornwell, Jacob Rauers, E. H. Green, H. M. Comer, Abram Mills, William Hunter, John M. Guerard, George J. Mills and W. W. Gordon.

of the Des Moines, Northwestern & Wabash Narrow-Gauge road, vice H. B. Skeele, resigned.

CINCINNATI & EASTERN R. R.—Mr. W. L. King has been appointed road-master, with office in Cincinnati. Mr. J. G. Bates will be assistant to Mr. King.

ILLINOIS & ST. LOUIS R. R.—Mr. Thomas McKissock has been appointed general manager. He served formerly on the Iron Mountain and the St. Louis, Kansas City & Northern roads.

SAUK CENTRE SOUTHERN R. R.—Chief engineer is W. R. Gillis, with office at Sauk Centre, Minn.

DANVILLE & NEW RIVER R. R.—This company has let the contract for the extension of the road from Martinsville, Va., to Patrick Court House, to A. B. Fortune of Asheville, N. C., work to be begun at once. The distance is 32 miles. The company is to furnish the rails.

LEHIGH & EASTERN R. R.—This old project is revived by the organization of a construction company for the purpose of building the road. The line as projected is from Tomhicken, Pa., to the Delaware River and up that river to Port Jervis, N. Y. Work has been begun on the road a number of times, but very little has actually been done.

LONDON CORRESPONDENCE.

LONDON, Dec. 23, 1882.

With the approaching end of the year business slackens, and even those who would go on are compelled to rest on their oars. It is, therefore, a strange fact that during the past week the iron trade in Great Britain should have shown a distinct improvement. The change was first observable in Glasgow, where the pig-iron market is much firmer. The more favorable tendency may, however, be partly attributed to more favorable reports from your side and to the belief which is more and more gaining ground that Congress will pass an act to reduce the duties on iron and rails. In the meanwhile warrants of pig-iron, which closed a week ago at Glasgow at 49s. 2d., closed yesterday at 49s. 8d., and although the highest point reached during the day—50s. 3d.—was not maintained at the close, the tone continues very strong. Prices of pig-iron in Middleborough are also firmer at 43s. to 43s. 6d. for No. 3. Hematite iron remains quiet at 54s. to 56s. Finished iron remains quiet in Scotland and Cleveland, but in the Midlands prices are advancing. The tin plate trade has improved, the failures in South Wales not being by any means an unmitigated evil. Ordinary cokes are now quoted 16s. 6d. to 17s. per box. The steel trade is very brisk, and a considerable demand has set in for forward contracts, more particularly for railway material. The shipbuilding trades are very busy.

Amongst the orders which have lately been received is one obtained by Messrs. Jones Brothers, of the Ayrton Rolling Mills, for 1,000 tons of steel

plates for Glasgow, the blooms of which will be supplied by the Darlington Iron Company. Considerable new works is being done at the works of the Northeastern Railway Company, at Gateshead, where some large locomotive orders are in hand.

The iron markets of the Continent continue quiet; this refers especially to manufacture of iron in Belgium. Pig-iron is steady in France, whilst finished iron is weaker. There is considerable weakness in the Rhenish pig iron markets, but if the improvement in our markets should continue, prices will also advance on the Continent.

CREUSOT.—The profits realized by the Creusot Works (MM. Schneider & Co.) in 1881-2, are officially returned at £270,840. The value of the work turned out during the year was £2,286,205. The prospects of the current financial year are considered good.

Mr. Delford, inspector of rails for the French government, after inspecting the basic process at Creusot, thus concludes his report:

"We can say that the problem of the manufacture of steel from phosphoric pig is solved, both for the Bessemer and open-hearth processes, by the employment of a peculiar lining of magnesian lime. The removal of phosphorus is as satisfactory as possible, that of silicon is almost complete, and a great part of the sulphur is also removed. The series of analyses quoted show that the basic steel is purer than the acid steel, and is more uniform in composition. The mechanical tests of tensile strength show that the basic steel is appreciably more regular than the acid. The rails manufactured with the two kinds of steel give equally good results, The State has, therefore, decided to accept indifferently rail tenders for acid and basic steel. In the Siemens furnace the Gilchrist-Thomas process is more easily carried out than even in the converter, and the dephosphorization is more complete."

THE HISTORY AND STATISTICS OF AMERICAN WATER-WORKS.

BY J. JAMES R. CROES, M. AM. SOC. C. E.

(*Continued from page* 444, *Vol. IX.*)

CCCCLI.—CRESTLINE, O.

Crestline, Ohio, in lat. 40° 55′ N., long. 83° 50′ W., is on rolling ground.

Settled in 1850, it was incorporated a city in 1855.

Water-works were built by the city in 1870, after plans of Mr. Morgan, taking the supply from springs, the water of which is collected in a reservoir of earth and stone, 120 by 280 ft., and 8 ft. deep, at 127 ft. above the city.

Distribution is by 10 miles of Wyckoff wooden pipe, of from 8 to 4-in. diameter, with 28 fire hydrants, 32 gates and 100 taps. Service pipes are of galvanized iron.

The population in 1880 was 2,848. The daily consumption is not known.

The works cost $60,000. The bonded debt is $55,000, at 5 per cent. interest. The expenses in 1881 were $600, and the receipts $1,600.

The works are managed by three trustees. Louis Holcker, one of the trustees, is the Secretary, and John Reid, Superintendent.

CCCCLII.—CHARLESTON, ILL.

Charleston, Illinois, in lat. 39° 32′ N., long. 88° 8′ W., is on an undulating prairie, 3 miles west of the Embarras River. It was settled in 1833, and incorporated as a city in 1873.

Water-works were built by the city in 1876, taking the supply from the Embarras River, which is 134 ft. below the city, and pumping directly into the mains, through 2¾ miles of 12-in. cast-iron pipe, by Dean Brother's duplex pumps, of 2,000,000 gallons capacity. The ordinary pressure at the pumps is 65 lbs., and the fire pressure 100 lbs.

Distribution is by 6 miles of cast-iron pipe of from 8 to 6 in. diameter, with 30 fire hydrants, 17 gates and 92 taps. There is 1 meter in use. Service pipes of lead, of plain wrought-iron and of galvanized-iron are used. The population in 1880 was 2,867. The daily consumption is not given.

The works cost $47.500. The bonded debt is $30,000, at 10 per cent. interest. No further financial statistics are given.

The works are controlled by a board of four commissioners appointed annually by the mayor. A. F. Walker is the superintendent.

CCCCLIII.—CUMBERLAND, MD.

Cumberland, Maryland, in lat. 39° 40′ N., long. 74° 45′ W., is on rolling ground on the Potomac River.

Water-works were built for the city in 1871 by the Holly Manufacturing Co., taking the supply from the Potomac River and pumping directly into the mains. The works were enlarged in 1873 and additional engines put in. The works were then reported to be pumping 3,400,000 gallons daily for the city and the Baltimore & Ohio Railroad shops. In 1880 the pumping machinery was replaced by new Holly pumps.

Distribution is by 24 miles of cast-iron pipes of from 12 to 3-in. diameter, with 106 fire hydrants, 47 gates and 1,200 taps.

The population in 1880 was 10,693. The daily consumption in 1882 was 1,500,000 gallons. The Baltimore & Ohio shops and hotels are now supplied from works erected by the railroad company.

The works have cost $190,000, which is the amount of the bonded debt, $150,000 being at 7 per cent. and $40,000 at 6 per cent. interest. The expenses for the year ending May 31, 1882, were $5,132, and the receipts $6.834.

CCCCCLIV.—PETROLIA, PA.

Petrolia, Pennsylvania, in lat. 41° N., long. 79° 50′ W., in a narrow valley on Bear Creek, was settled in 1872 in the centre of the petroleum basin of Butler County, and is noted for its large oil wells and as the terminus of the first narrow gauge railway in Pennsylvania. It was incorporated as a city in 1873.

Water-works were built in 1874 by a private company after plans of F. S. Masson, taking the supply from an artesian well of 5⅝ in. bore, which yields about 200,000 gallons of water at a temperature of 51° F. The water is pumped by a Blake steam pump, to a wooden tank holding 48,000 gallons, at 175 ft. above the city.

In 1876 the increase of population was so great that the works were insufficient for fire protection, and a 40 horse-power Blake pump was erected and connected with an independent fire main of 2½-in. wrought-iron pipe, which has been satisfactory. Distribution is by 5 miles of wrought-iron pipe of 3½ and 2 in. diameter, with 15 fire hydrants, 7 gates and 25 taps. The city pays $170 per year for fire hydrants. Service pipes of lead and of galvanized iron are used. The population in 1880 was 1,186. The daily consumption in 1881 was 40,000 gallons.

The capital stock of the Petrolia Water-Works Co., Limited, which purchased the works in 1880, is $1,200. The works have cost $8,000 and the receipts have been $30,000. There is no debt. The expenses in 1881 were $1,956.91 and the receipts $2,754.96.

S. W. Harley is secretary, and F. L. Masson has been the superintendent from the beginning.

CCCCLV.—HORNELLSVILLE, N. Y.

Hornellsville, New York, in lat. 42° 16′ N., long. 77° 45′ W., is on the Canisteo River.

Settled in 1820, it was incorporated as a village in 1852. Water-works were built by a private company in 1882, after plans of W. B. Rider, C. E., and under superintendence of Arthur L. Betts, C. E. The supply is taken from springs, the water of which is stored in a reservoir of 15 acres, formed by a dam 450 ft. long and 23 ft. high, 5 miles from and 220 ft. above the village. In the outlet chamber in the dam, the water passes through gravel and charcoal between wire screens. It is conveyed to the village by a 16-in. cast iron pipe.

Distribution is by 13 miles of cast-iron pipe of from 10 to 4 in. diameter, with 110 fire hydrants, 93 gates and 150 taps. The village pays $30 per year for each hydrant. Service pipes of plain wrought iron, of galvanized iron and of lead are used.

The population in 1880 was 8,195. The daily consumption is not given.

The capital stock of the company is $125,000. Its works have cost $200,000. The bonded debt is $150,000 at 6 per cent. The charges for water service began Dec. 1, 1882.

S. H. Crane is Secretary and Treasurer, and A. W. Inman, Superintendent.

The receipt of statistics as follows, is acknowledged with thanks: From E. V. Boulton, Secretary, statistics of Kenton, Ohio, water-works. From W. O. Sprigg, statistics of water-works of Cumberland, Md. From S. H. Crane, Secretary, statistics of Hornellsville, N. Y., water-works. From W. D. Pollard, Secretary and Engineer, statistics of Pottsville, Pa., water-works. From N. J. Gaylord, Superintendent, statistics of Ludington, Mich., water-works. From Joseph Ecoff, Superintendent, statistics of McKeesport, Pa., water-works. From F. S. Masson Superintendent, statistics of water-works of Petrolia, Pa. From Louis Holcker, Secretary, statistics of water-works of Crestline, Ohio. From Percy M. Blake, C. E., statistics of Northborough, Mass., water-works. From A. F. Walker, Superintendent, statistics of Charleston, Ill., water-works. From H. J. Corant, Clerk and Treasurer, statistics of Southbridge, Mass., water-works. From W. R. Billings, Clerk Water Board, revised statistics of Taunton, Mass., water-works. From George Howard, Chairman, statistics, reports and water-rates of the Guelph, Ontario, water-works,

THE FAILURES OF A YEAR.

The annual circular published by R. G. Dun & Co.'s mercantile agency gives the number of failures in the United States for the year as 6,738, with liabilities aggregating $101,547,564. The percentage of failures was 1 in every 122 engaged in business, and the average liabilities were $15,070. These figures in every respect show a marked increase over the first two years of the present decade, and are larger than in any year since 1878.

In commenting upon the probabilities and possibilities of a better record in a business way for the present year, providing the dangers from overmanufacture and an unwise extension of credit are eliminated the circular takes the following roseate view:

"A year of unbounded production in almost every department of industrial activity has just closed: the accessions to the population by immigration have been beyond all precedent; the late Autumnal season was so extremely favorable as to add greatly to the value of the flocks and herds scattered over the country, while the early Winter thus far has been extremely propitious for numerous interests. Legislation in Congress promises to be highly advantageous to the future ease and freedom of business. The possibility of a reduction in taxation by the removal of internal imposts and the release of vast sums of money hitherto locked up for the payment of the rapidly decreasing public debt, must all tend in a direction to not only lessen the burdens under which business in some departments has struggled, but to beget ease and activity generally. As yet the farming community have realized upon but a very small portion of the vast stores with which the year has replenished their granaries, and the exports, which already begin to climb to very respectable dimensions, must necessarily vastly increase within the next few months. Railroad earnings must grow in proportion, and the whole condition of the commerce of the country promises a greater safety, magnitude, and success than have ever before been attainable. A condition of preparedness to to take advantage of the favorable circumstances now existing is found in the fact that speculation to an unwise extent has perhaps spent itself, and that the results of a large decline in values, as a consequence, have not been attended with very numerous disasters, though the surplus of many has been lessened thereby. It is a testimony to the generally sound condition of the country that a reduction so large in the price of securities and leading staples could be endured with consequences not more hurtful than are apparent from the figures of failures we herewith present."

CORRESPONDENCE.

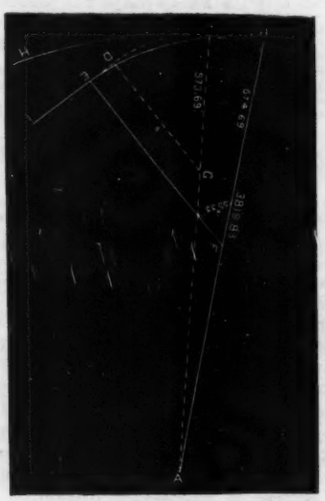
LOCATING CURVE.

PITTSBURGH, Pa., Dec. 30, 1882.

EDITOR ENGINEERING NEWS:

I would be pleased to receive a solution of the following problem:

BCH is a 1° 30′ curve of indefinite length. At *B* it compounds into an 8° 30′ curve ending at *E*, this curve having a central angle of 55° 30′. It is



desired to change this curve to a 10°. At what distance from *B* on the 1° 30′ curve should the new point of compound curvature *C* be located in order that the new curve may end tangentially at *D*, being on the old tangent *IE* prolonged? Required also the angles *BAC* and *CGD*, the sum of which should equal *BFE*, or 55° 30′.

Respectfully, L. E. VEL.

IRON AND METAL MARKETS.

[From the *Iron Age*, Jan. 3.]

The following is the London quotation of the above date:

Steel Rails.—The demand continues small and quotations nominal. Ordinary Sections are quoted, nominally, £4 17s. 6d.@£5 12s. 6., f. o. b. shipping ports.

Iron Rails.—Nominal; Welsh, £5.

Old Rails.—Without change. Offerings are moderate and sales small. Quotations are nominal. We quote,

nominally, c. i. f. New York: Old Ts, £3 17s. 6d.@£4, and old D. Hs., £4 5s.

NEW YORK.

Rails.—It is stated by well-informed parties in the steel rail business that the low price ruling for some time past has so stimulated buyers that nearly, if not all, of the Bessemer rail mills in the country are now sold up for about six months ahead. The price is firm at $40 at Eastern mills.

Financial.—The year 1883 opens hopefully. The usual period of financial stringency incident to the annual settlements passed almost without observation, and in the survey of the business field there is found nothing to excite special disquietude. It is admitted that in many departments production has outrun consumption; hence transactions are on a reduced margin of profit, and a spirit of conservatism, rather than of adventure or speculation, is the predominant feature. In the retrospect it is found that if at any period disaster threatened as a consequence of the deficient harvest of 1881, the crisis passed with nothing more serious than labor strikes among various classes and a temporary embarrassment of manufacturing operations. The prolific crops of the past year at once give stability to the financial fabric, but the more sanguine expectations formed at the outset were realized only in part. There is a concurrent opinion, widely entertained, that, despite the misgivings of some, the business of the country rests on a substantial basis. Values, it is reasonably believed, have receded nearly, or quite, to the lowest point under a wholesome reaction, and, sustained by the abounding resources of the great agricultural sections, a gradual renewal of activity will be looked for with more of confidence than distrust.

Government bonds were firm, and to-day were active, financial institutions being heavy buyers. The closing quotations were as follows:

	Bid.	Asked.
U. S. 5s, 1881, continued at 3½	*102	....
U. S. 4½s, 1891, registered	113¼	113¼
U. S. 4½s, 1891, coupon	113¼	113¼
U. S. 4s, 1907, registered	119⅝	119⅝
U. S. 4s, 1907, coupon	*119⅝	119⅝
U. S. 3 per cents	*102¾	103
U. S. Currency 6s, 1895	129	....
U. S. Currency 6s, 1896	130	....
U. S. Currency 6s, 1897	131	....
U. S. Currency 6s, 1898	132	....
U. S. Currency 6s, 1899	133	....

* Ex interest.

PITTSBURG.

Manufactured Iron.—Demand is light at present, as usual just at this time, but, as there has been a good deal of inquiry for some time past, it is expected that orders will soon commence to come forward, and that a number of large contracts will be placed here during the present month. Manufacturers generally are in good spirits, in anticipation of a healthy legitimate trade, and there is no reason apparent why their expectations should not be realized. While the card remains unchanged, we continue to quote on a basis of 2.25c. rates for bars, 60 days, with the usual discount of 2 per cent. off for cash.

Wrought Iron Pipe.—This important branch of the iron business is dull, and will continue so until the spring trade opens up. Contracts could be made for future delivery at low prices, but manufacturers are refusing to take them. Prices, it is believed, have touched bottom, and buyers, it is asserted by some well-informed operators, need not be afraid of buying at quoted rates, which are very low. Discounts on gas and steam pipe, 67½@70 per cent.; on boiler tubes, 55 @57½ per cent. Oil-well supplies dull. Oil-well tubing quoted at 18@20c. per foot, net; do. casing, 65c. per foot, net.

NEWS OF THE WEEK.

THE "GILT EDGE" ROAD, Jan. 2.—When the engineering corps which is surveying the projected Gilt Edge Line, parallel to the Nickel-Plate and Lake Shore roads, reached Woodland Hills, Cleveland, at a point within a few rods of the Nickel-Plate, operations were stopped abruptly and the corps it is understood returned to a point on the Lackawanna, from which a line will be surveyed to Olean, N. Y., where the old road-bed of the Clinton Air Line, a part of the old Continental scheme, which fell through a quarter of a century ago after being two-thirds constructed, will be reached and followed to Hudson, O., 20 miles southeast of Cleveland. From there the scheme contemplates building independently from Hudson to Akron, and from Akron to Toledo jointly with the Pittsburgh, Youngstown & Chicago to connect with the Wabash. The old Continental Line is parallel with the New York, Pennsylvania & Ohio and Erie roads, and nearly in entire distance from Olson to Hudson, about 280 miles, and if built will divide the business of the New York, Pennsylvania & Ohio, which will also furnish a much-desired Eastern outlet for the Cleveland, Akron & Columbus road, which terminates at Hudson. The opinion is gaining ground that the projected new trunk line is a Gould scheme, and that it will be built. The object of the present survey is to see whether the line can be built more economically than that now surveyed parallel with the Nickel-Plate.—*St. Louis Globe-Democrat.*

SPARTA & CINCINNATI RAILROAD.—This company has been organized to build a railroad from Sparta, Tenn., the terminus of a branch of the Nashville, Chattanooga & St. Louis, eastward about 50 miles to a connection with the Cincinnati Southern near Rockwood.

RIVER HARBORS.—The House recently asked the Secretary of War to report whether in the last River and Harbor bill works were appropriated for which were not beneficial to commerce. Secretary Lincoln replies that, while it has not been the practice of the Department to express opinions as to the wisdom of appropriations, he has made an investigation, and finds that in many instances the results of substantial benefits to commerce were obscure and apparently insignificant. The estimates of the Engineer Department for the improvement of rivers and harbors for the next fiscal year amount to $33,889,000.

HARTFORD & HARLEM R. R.—Articles of association of the Hartford and Harlem Railroad Company have been filed in the Connecticut State Capitol, organizing under the general railroad law. The road is to run from the State line in Greenwich to the town of Hartford, going through the same towns as the New York, New Haven and Hartford road. Among the subscribers to the stock are Charles G. Francklyn, of New York, for 3,000 shares of $100 each; Lewis M. Brown, of New York, 1,000 shares; L. W. Higginson, of Boston, 4.319 shares, and Albert M. Billings, of Chicago, 1,000 shares. The directors are Albert M. Billings, Lewis M. Brown and Frederick W. Bruggerhoff, of Norton, Conn.; Warren H. Day, of Bridgeport, Charles G. Francklyn, of New York, F. L. Higginson, of Boston, Henry G. Lemis, Samuel G. Thorn, John E. Bassett and Henry Kellam, of New Haven, and Chas. A. Whittier, of Boston. The directors take oath that $436,000 ($500 per mile) has been subscribed, and that ten per cent. of this has been paid in.

HARTFORD, Jan. 3.—The Hartford and Harlem Railroad Company to-day filed a petition asking permission to consolidate, make joint stock, or otherwise unite with such corporation or corporations as may own, hold or control any franchises or property in the State of New York as may enable it to make a continuous line to New York city; also, to impose a mortgage upon the entire road in both States to secure bonds issued by such consolidated company for the purpose of speedily building the road from New York city to Hartford.

HARTFORD, Jan. 4.—Regarding the proposed Hartford & Harlem Railroad, ex-Governor Jewell, of this city, who was in the parallel road movement of last year, says he believes the road will be built, but declines to say more. A director of the New York, New Haven & Hartford road doubted the ability of the new road to get into New York city. The charter is only to the New York State boundary. He quoted Commodore Vanderbilt as saying that it would cost $25,000,000 to get a road into New York. The new scheme is looked upon as a New York and New England railroad operation.

BOSTON, Jan. 4.—The *Transcript's* financial article this afternoon says: "The scheme for a parallel road to the New Haven & Hartford road, over 100 miles from Hartford to the Hudson River, is backed by English capitalists, represented by C. G. Francklyn. It is partly in the interest of the New York & New England Railroad. The latter road has not yet sold its second-mortgage bonds, but has had an order therefor."

GENERAL GRANT'S RAILROAD IN GUATEMALA.—The *Guatemalteco*, of Dec. 12, publishes a translation of a contract, signed in New York, on Oct. 6 last, between General Barrios and Gen. Ulysses S. Grant, President of the Mexican Southern Railroad Company, under which, in return for certain concessions, this company undertakes to build 250 miles of railroad in Guatemala within two years after the Mexican Southern line reaches the Guatemalan frontier.

MISSISSIPPI RIVER IMPROVEMENT.—The Mississippi River Commission submitted its report to Congress on the 2d. At Plum Point and Lake Providence the work has been greatly delayed by the scarcity of labor. The river has been divided into four administrative districts, each in charge of an engineer. On the upper Mississippi, below Des Moines River, work has been carried on only at those places where navigation is most impeded; on the river below the junction with the Missouri only continuous work affords any prospect of success.

The principle on which the work is carried on below Cairo is the contraction of the width of the river and protection of the banks, to secure the scouring out of the bottom and a prevention of the formation of bars. The cost of carrying out the improvements during the next fiscal year will be $4,573,000.

NEW YORK DOCKS.—At a recent meeting of the Dock Commission Mr. Greene, the engineer, submitted plans, specifications and estimates of forty piers to be built along the East River from Grand street to Thirty-fourth street, the upper section, from Fourteenth to Twenty-sixth street, to be used entirely for the vessels in the Sound trade. The estimate of the cost was $10,000,000.

NEW WAR SHIPS.—The Naval Advisory Board recommend that the largest of the steel cruisers authorized by Congress be not built, because the appropriation made for these ships of $2,700,000 would not cover the cost, and because the vessels of medium size should be built first, the larger ones not being needed at present.

PROVIDENCE (R. I.) CITY DEBT.—$8,479,818, a decrease in one year of $223,221.

IRON RESIDENCE BUILDING.—George L. Houston is building at Parkesburgh, Pa., a residence wholly of iron, on a foundation of solid rock. The floors will be of polished cast iron tiles, in which different qualities of the metal will be used to produce a variety of colors. All the partitions, as well as the outer walls, will be of iron surface, but so painted and ornamented as to look like wood. In the library will be a cabinet for the exhibition of iron specimens. This will be constructed of magnetized iron, so that the specimens will adhere to it by magnetic attraction.

CINCINNATI'S WATER-WORKS.—The company completed their improvement and turned on the water on the 1st. This improvement gives the city a capacity of 15,000,000 gallons every 24 hours.

A NEW NIAGARA BRIDGE.—It seems now to be settled that the new suspension railroad bridge, to be built for the accommodation of the Michigan Central and Canada Southern railroad companies, will be constructed below the Falls.

BORDENTOWN WATER-WORKS BURNT.—The works that supply Bordentown, N. J., with water, with all their machinery, were burned on Tuesday night. They were owned by a private company. It is said that the fire was the work of an incendiary.

Bordentown is a city of 6,000 inhabitants. Waterworks were built after the plans of J. W. Allen in 1856. The daily consumption is 150,000 gallons. The works cost $40,000. For further description see History and Statistics of American Water-Works, ENGINEERING NEWS, vol. IX., page 131.

VALUE OF A HEALTHY MAN, ETC.—In the trial of the suit of the Administrator of Cephas M. Woodruff against Henry S. Little, Receiver of the New Jersey Central Railroad, to recover damages for the killing of Mr. Woodruff in the Parker's Creek disaster, before Judge Depue, Newark, on the 4th, B. J. Miller, of the Mutual Benefit Life Insurance Company, testified that the present value of an income of a man 51 years of age, in good health, at $5,000 per annum, is from $52,000 to $57,000.

BOSTON, HOOSAC TUNNEL AND WESTERN RAILROAD.—At a meeting of the directors of the Boston, Hoosac Tunnel and Western Railway in this city, on the 4th, it was voted that all work west of the proposed connection of their road with the West Shore line, at a point about 5 miles west of Schenectady, should be stopped, and that all of their road's interests west of that point to Syracuse should be sold to the West Shore Company. The Boston, Hoosac Tunnel and Western Company is to confine its efforts to developing and improving its present road from the Massachusetts State line to a connection with the Erie Canal and the New York Central and West Shore roads, a few miles west of Schenectady, and of its branches from Mechanicsville to Saratoga Springs. Joint contracts, also, have been entered into whereby the Boston, Hoosac Tunnel and Western road will be used by the West Shore Company for its principal New England connection, via the Tunnel. It is understood that the Boston, Hoosac Tunnel and Western Company will keep up its present connections with the Erie Railway, and that it can take business from the Erie Canal, also, if found advisable. The West Shore Company hope to have the road opened to Buffalo and ready for traffic next fall.

BIDS FOR THE YORKTOWN MONUMENT.—Bids for the building of a monument at Yorktown, Va., were opened on the 4th, in the office of Richard M. Hunt, architect of this city, and chairman of the Commission on Design. There were present, besides Mr. Hunt and the bidders, Lieut.-Col. Wm. P. Craighill, Corps of Engineers, United States

Army, and J. Q. A. Ward, the sculptor. The plans and specifications provided for a granite monument about 85 ft. high, rising from a base about 31 ft. square, and surmounted by a statute of Liberty 13 ft. high. The following bids were received: Hallowell Granite Company, $59,487; the same company, for Indiana limestone, $58,500; the Bardwell Granite Company, $60,436; the Westham Granite Company (Richmond, Va.), $74,987.87; Hurricane Granite Company, by David Tillson, $60,000; New England Granite Company, by David C. Hutchinson, $74,000; Pierce & Monroe, for Mount Waldo Company, $74,500; Brown & McAllister, $115,000; E. C. Sargent, Concord (N. H.), granite, $99,000. Each bid was accompanied by specimens of the granite proposed to be used. The bids will be officially reported to the War Department.

A CANADA LAND CO.—A special cable despatch from London to the *Globe* says: "There is a movement on foot to call a meeting of the shareholders of the Canadian Northwest Land Company, or form a committee to investigate the position of the company and its relations with the Canada Pacific Railway Company; also to ascertain the reason for the Duke of Manchester's retirement. Much anxiety prevails among some of the shareholders."

COLD WEATHER.—The thermometer in Winnipeg registered 39° below zero on Thursday. On the top of Mt. Washington, N. H., the mercury stood at zero, and the wind was blowing 144 miles per hour.

JAY GOULD'S MEXICAN RAILROAD.—A special from Laredo to the Galveston *News* of the 4th says: "It is reported that the Mexican Government has taken possession, under forfeiture, of the road bed and fixtures of the Gould-Degress concession, known as the Mexican National Extension."

NEW FLOUR MILL.—Plans were filed in the Building Bureau on the 5th by George V. Hecker for a flour mill, to be erected on the site of the one burned last summer. It will have a frontage of 120 ft. on Peck slip, 129 on Water street, and 126 on Cherry, and will cost $75,000.

MINNESOTA STATE TREASURY.—The State Treasurer's report shows overdrafts of $142,810, which leaves no funds for current expenses. The Governor suggests a temporary loan.

INUNDATIONS IN EUROPE.—Jan. 4.—The great dam at Ludwigshafen, opposite Mannheim, on the Rhine, gave way last night. The lives of hundreds are imperilled; 60 or 70 lives have been lost. At Vienna the Danube has risen about 15 ft., and a thousand persons were driven from their homes. The railroad bridge to Moravia has been demolished. In France the Paris & Lyons Railway, on the French frontier, is washed away; the rivers Saône and Doubs have inundated several villages. The river Seine has reached the level of the December flood.

STRAW LUMBER.—Edward A. Kent, a Chicago architect, has been examining specimens of straw lumber in answer to inquiries made by the *American Architect and Building News* of Boston, to which journal Mr. Kent reports:

"Of the specimens examined, all were a yellow-brown in color, $\frac{5}{16}$" × 33" × 15' in size, being six (6) layers in thickness. The cement appears a glue rich in resin, and it or the rollers have given a sizing to both sides which is imperfectly cemented—all is so toward the edges. It cuts well, saws well, and can unquestionably be carved, but is at present unfit for inside finish on account of the rough surface it presents for oiling.

"It does fairly well for ceilings and floors, but the success of the product in the future is dependent on more perfect cohesion of the layers, to prevent warping.

"I inclose a circular of a Kansas company, whose claims for the *constructive* use of the product I consider more justifiable at present than for the *artistic* uses hoped."

Mr. Kent probably is the person to communicate with on the subject of straw lumber.

THE COUNCIL BLUFFS, IA., WATER-WORKS.—Work on the reservoir, engine-house, mains and machinery is progressing most favorably.

THE RICHMOND, VA., WATER-WORKS.—There were laid down during the year 7,642 ft. of 6-in., 2,216 ft. of 4-in., 1,466 ft. of 3-in., and 960 ft. 12-in. cast-iron water-pipe, making 2 miles 1,724 ft. From these and other mains of the works there have been put in 22 double-nozzle fire-plugs. The extension of the city another year will very probably require as many new mains as the past. The receipts were $75,722, and the disbursements $53,-186.

CHICAGO'S BUILDING STATISTICS FOR 1882.—The number of permits issued was 3,640. The street frontage covered with new structures, lineal measure, was about fourteen miles, and the total cost of buildings erected was about $20,000,000. The larger portion of the new buildings are two and three stories high, about one hundred are four stories, seventy-five five stories, and thirty-six stories. There are a few seven, eight, nine, and ten story buildings. The totals show that the expenditure this year has been about one-half that of the year 1872, when the rebuilding of the city, after the fire, was going on.

THE SWAMPSCOTT WATER SUPPLY.—Lynn, Mass., has been enjoined by the Supreme Court from furnishing water to Swampscott.

AN ELECTRIC LIGHT TOWER.—The material for the tower to be erected at Fond du Lac, Wis., is all on hand, and the work is progressing rapidly.

GAS WORKS INADEQUATE.—The present gas-works are not large enough to manufacture the gas necessary to supply Richmond, Va.

AN AUSTRALIAN RAILWAY.—A dispatch from Sydney says that the construction of a railway from Brisbane to Port Darwin is decided upon.

BRANCH OF THE INDIANAPOLIS AND ST. LOUIS RAILROAD.—It is stated that a branch of this road will be built from Carbon to Brazil within the next few months.

TRANSMISSION OF POWER BY ELECTRICITY.—At the works of the Railway and Electric Appliances Company, Polmadie, the first practical application of the transmission of power to a distance in everyday use in Scotland has been made by Mr. Rankin Kennedy, electrician and engineer. By means of two dynamo-electric machines, a power of from four to five horses is transmitted from the line shafting of the turning and fitting shop of the works through two small copper wires to the department occupied by the carpenters and pattern-makers on the opposite side of the yard of the works. The power thus transmitted is used by the carpenters and pattern-makers for driving the large saws cutting their wood, and is completely under their control. Logs of wood 7 in. thick can easily be cut up by the circular saw driven in this way.—*London Ironmonger.*

THE CHICAGO ELECTRIC ELEVATED RAILROAD.—The incorporators, if they secure favorable action by the city council, will make electricity the motive and lighting power.

THE TEXAS & ST. LOUIS NARROW-GAUGE.—This road is completed from Bird's Point, opposite Cairo, Ill., to Clarendon, Ark., a distance of 216 miles. Only 40 miles of track remain to be laid.

NEW RAILROAD COMPANY.—A company has been formed for the purpose of extending the line of the Cincinnati & Westwood Narrow-Gauge road. The name is to be changed to Cincinnati & Western, and the work of building as far as the Big Miami is to be begun at once.

A TEXAS BRIDGE NEARLY FINISHED.—The Brazos bridge of the Western Narrow-Gauge road is nearly finished.

RAILROAD SCHEME REVIVED.—The scheme to build a railroad from Vincennes to Jasper, Ind., has been revived.

BUILDING IN DETROIT.—The returns of the Fire Marshal for the year 1882 show that new buildings authorized during the year amount to $3,057,064, and repairs $383,017. This is an increase of $1,000,000 over 1881.

BRIDGE OVER THE MISSOURI AT BOONVILLE.—Since the attention of the Missouri Pacific Management was called to the condition of the bridge of the M. K. and T., a new floor system has been provided, and it is now decided to greatly increase the capacity. A contract has been made to take down the cast-iron top chords of all the spans and to replace them with wrought-iron chords; also to substitute steel pins in all connections in place of iron, and proportion the trusses to carry in addition to their own weight a moving load of two consolidated engines with tenders. The work is to be commenced and completed as soon as possible.

PROPOSED LARGE BUILDING.—Messrs. Robert and Ogden Goelet will erect an office building on Whitehall street, this city. It will be 123x92x76 and eight or ten stories high.

ST. CHARLES BRIDGE.—The middle and eastern channel spans are completed in every particular. The Fink spans have been reformed with substantial timber bents on piling—three bents under each span. The two Fink spans just east of the through span will be taken down in the coming spring and Whipple trusses erected instead. Subsequently the remaining Fink spans will be similarly treated. The masonry piers for the additional bents for the approaches are all completed. The bents and trusses over the street crossings on the St. Charles side have all been renewed and greatly strengthened. The iron-work for the new approaches is all ready and has begun to arrive at St. Charles, and the work of erection will soon commence. The approaches will be entirely renewed, and the spans between the bents reduced from 32 ft. to 16 ft.

ENGINEER'S BOOK OF TABLES.—Edward S. Shaw, a well-known civil engineer of Cambridge, Mass., writes: "The little pamphlet is unique and valuable—worth triple its cost."

KASKASKIA RIVER, ST. ELMO & SOUTHERN RAILWAY.—This is a newly projected road, designed to run from Paducah, Ky., through Marion, Benton, Mt. Vernon, Salem, Kinmundy, and St. Elmo to Stewardson, Shelby Co., Ill., or perhaps to some point still further north. The preliminary surveys have been made from Marion to St. Elmo, and will be completed to Stewardson this week. A great deal of interest is being taken in the project by the people along the line, and already about three-fourths of the right of way has been secured, although the company is only about two months old. The road runs through a very fertile section of the State, which is but poorly provided with outlets in the natural direction for their traffic, and is considered as promising a project as any now in view in Illinois. It is expected to commence construction as soon as the ground becomes settled in the spring. E. W. Muenscher, Sr., formerly city engineer of Grand Rapids, Michigan, is chief engineer. The offices of the company are at St. Elmo, Fayette Co., Ill.

ELEVATED RAILROAD SUITS.—The Court of Appeals will be full of business after the middle of the month in hearing cases for damages brought against the Metropolitan Elevated Railway Company. Already damages to the amount of $735,-000 are sued for, and there is more to come. If the decisions are adverse to the company it may result in closing the road temporarily.

AUSTRALIAN RAILWAY.—It is now decided to build a railroad across Australia from Brisbane to Port Darwin.

CANADA PACIFIC RAILWAY.—Seven thousand men are now working on the British Columbia section of the Canada Pacific Railway.

YALE COLLEGE FUNDS.—The aggregate of all the funds of Yale College amounts to $1,826,582.69, of which the Sheffield Scientific School has $141,-263.64.

NEW YORK CITY ESTIMATES.—The estimates allowed for the city government for 1883 amount to $28,593,535.

OLD TREATISE ON SURVEYING.—Mr. George Raymond, civil and hydraulic engineer, of Fitchburg, Mass., writes us as follows: "I noticed an article in ENGINEERING NEWS, concerning old treatises on surveying. I have, now before me, a copy of the fourth edition of Love's 'Geodaesie,' published in London, 1731. Its ownership at a certain time is indicated by the following entry upon the title page, viz.: Thomas Hughes, Ejus Liber, October, 1753."

THE ANGULAR UNIT.—The unit to which all angles are referred may be defined as *that angle at the centre of a circle which is subtended by an arc equal in length to the radius.*

THE CIRCULAR MEASURE OF AN ANGLE.—This expression of an angle *is the number which expresses the ratio of the arc which subtends it to the radius of the circle,* as follows: A = the said number, a = length of arc, and r = radius of circle; $A = \frac{a}{r}$; if any two be given the third may be calculated.

RATIO OF CIRCUMFERENCE TO DIAMETER.—Circumference $= 2\pi r$; $\pi = 3.14159$.

CIRCULAR MEASURE OF A RIGHT ANGLE.—$\frac{1}{2}\pi$. There are 206265" = 57.3° in the angular unit. If A'' be the number of seconds in an angle which is subtended by an arc whose length is a, then $A'' = 206265'' \times \frac{a}{r}$, in which equation are connected together the radius, the number of seconds in the angle at the centre, and the length of the arc which subtends it; any two of these quantities being given, the third may be found.

EXAMPLES.—(1). The diameter of the earth is 7926 miles; its distance from the moon is 237638 miles; calculate the angle which the earth's diameter subtends at the moon.

(2). The angle which the moon subtends at the earth is observed to be 31' 07"; calculate her diameter in miles.

(3). The angle which the diameter of the earth subtends at the sun's center is 17.2". Calculate the sun's distance.

(4). The sun's diameter subtends at the earth an angle of 32" 03"; calculate its distance.

TO FIND THE DISTANCE OF THE SEA HORIZON IN MILES.—Let h be the height of the eye above the sea, expressed in feet, then distance in statute miles $= \sqrt{1.5h}$.

TO FIND THE DIP OF THE HORIZON.—The dip or depression of the horizon if the angle between the tangent to the earth's surface and the horizontal line drawn through the eye; it is equal in minutes to $1.06\sqrt{h}$. Owing to the refraction of light the dip is something less and in practice the following rule will answer: *The square root of the height expressed in feet is equal to the dip expressed in minutes.*